ERDC/GSL TR-17-8

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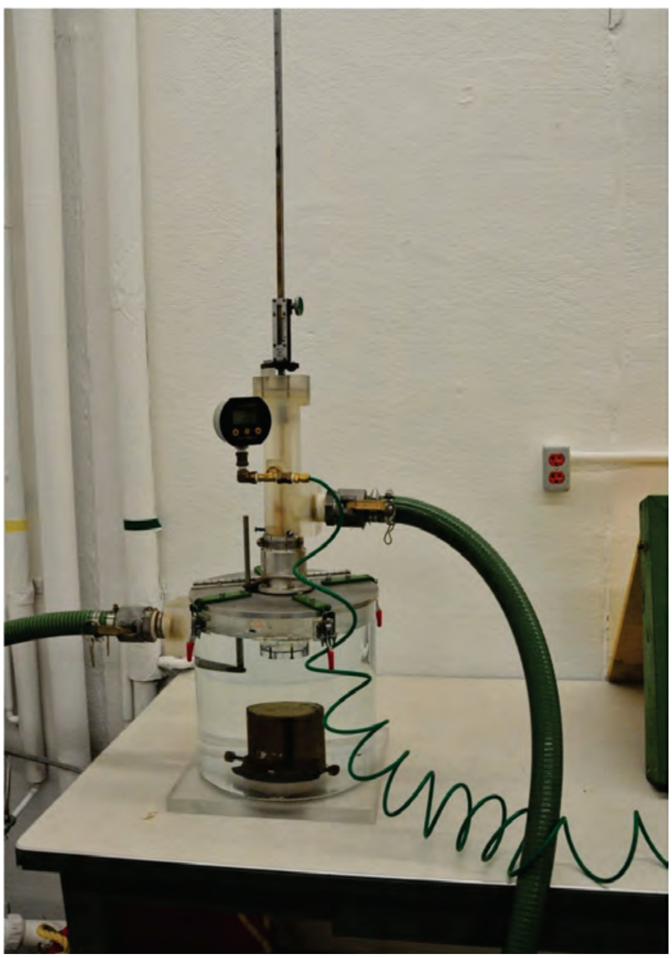
May 2017



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Final report

Approved for public release; distribution is unlimited.

Prepared for U.S. Army Corps of Engineers, Sacramento District
1325 J Street
Sacramento, CA 95814

Under Work Unit C4CL8D, "Evaluating the Mechanisms for Coarse-Grained Materials"

Abstract

This report summarizes the results of 42 laboratory Jet Erosion Tests performed on Plexiglas tube samples obtained from the Lower American River (LAR) between River Mile (RM) 6.0 and RM 10.0. The results from these tests will be used by the U.S. Army Corps of Engineers, Sacramento District, in assessments of the erosion resistance of the LAR from increases in discharge from 115,000 cfs to 160,000 cfs from Folsom Dam. The test specimens were obtained from 22, 4-in.-diam Plexiglas tube samples. The variations in values of the measured erosion parameters may have been caused by variations in the materials for some of the tested samples (i.e., when the material changed from silt/sand to clay). However, the variations in results for many of the samples were due to changes in the quality of samples. The resulting values of Erodibility Coefficient, K_d, and Critical Stress, τ_c, are very useful information in assessing the erodibility of riverbanks as well as the river bed itself. Because of the observed natural variability of the materials, combining the erosion parameters presented in this report with the drilling logs and local geology will provide beneficial results for assessing the stability of the LAR.

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Preface

This study was funded by the U.S. Army Corps of Engineers, Sacramento District, as part of a long-term investigation over concerns about the lateral channel stability of the Lower American River in response to higher discharges from Folsom Dam. The objective of the study was to locate "hardpoints" in both the bed and bank of the Lower American River.

The work was performed by the Geotechnical Engineering and Geosciences Branch (GSG) of the Geosciences and Structures Division (GSD), U.S. Army Engineer Research and Development Center, Geotechnical and Structures Laboratory (ERDC-GSL). At the time of publication, Mr. Chad A. Gartrell was Chief, CEERD-GSG; Mr. James L. Davis was Chief, CEERD-GSD; and Dr. Michael K. Sharp, CEERD-GZT, was Technical Director for Water Resources Infrastructure Research. The Deputy Director of ERDC-GSL was Dr. William P. Grogan, and the Director was Mr. Bartley P. Durst.

COL Bryan S. Green was Commander of ERDC, and Dr. David W. Pittman was the Director.

Unit Conversion Factors

Multiply	By	To Obtain
cubic inches	1.6387064 E-05	cubic meters
feet	0.3048	meters
gallons (US liquid)	3.785412 E-03	cubic meters
inches	0.0254	meters
pounds (force)	4.448222	newtons
pounds (force) per square foot	47.88026	pascals
pounds (force) per square inch	6.894757	kilopascals
pounds (mass)	0.45359237	kilograms
pounds (mass) per cubic foot	16.01846	kilograms per cubic meter
pounds (mass) per cubic inch	2.757990 E+04	kilograms per cubic meter
pounds (mass) per square foot	4.882428	kilograms per square meter
square inches	6.4516 E-04	square meters

1 Introduction

This study is part of a long-term investigation that is addressing the lateral channel stability concerns of the Lower American River (LAR) in response to increases in discharge from 115,000 cfs to 160,000 cfs at Folsom Dam in Folsom, CA. During the 1950s, the upgraded flood control levees in LAR were designed for 115,000 cfs. The Flood of 1986, with a peak discharge of 134,000 cfs, caused significant damage to the levees and river system due to bank erosion. Repairs were performed by the U.S. Army Corps of Engineers (USACE), the California Department of Water Resources (DWR), and the Sacramento Area Flood Control Agency (SAFCA). In 2004, the levees along LAR were reviewed for a potential discharge of 145,000 cfs, but the current plan is to increase the allowed release of Folsom Dam to 160,000 cfs. The study reach consists of the LAR, which includes the American River levees, bank, and channel from the South (left) Bank to the North (right) Bank between River Miles (RM) 10.2 and 5.25 (Figure 1). This extent includes (from upstream to downstream landmarks) the Watt Avenue Bridge, Howe Avenue Bridge, Guy West Bridge, H Street Bridge, and Paradise Beach/Glenn Hall Park.

1.1 Purpose

The purpose of this study was to perform Jet Erosion Tests (JETs) on samples collected from the riverbank and the channel of the LAR. The results of these tests will be used by the USACE, Sacramento District, to identify the erosion resistant material in the bed and bank of the river.

1.2 JET erosion tests

Forty-two JETs were performed in the U.S. Army Engineer Research and Development Center (ERDC) erosion laboratory by personnel in the Geotechnical and Structures Laboratory. The test specimens were taken from 22, 4-in.-diam Plexiglas tube samples obtained with a pitcher sampler. This was the first study of which the authors are aware where JETs were performed on undisturbed samples from the field. Typically, JETs are performed in situ (using a field apparatus) or are performed in the laboratory on compacted specimens. Performing JETs on undisturbed field samples adds an additional disturbance factor that has the potential to influence the test results. To account for this, two JETs were performed for each tube to

characterize the variability of the results due to the heterogeneity of the sample and sampling disturbance. Some disturbance of the samples was observed and is discussed in this report.

This report summarizes the results of the Phase 2 laboratory JETs performed on Plexiglas tube samples obtained from the LAR between RM 6.0 and RM 10.0, as shown in Figures 1 and 2. Nine Plexiglas tubes of soil were obtained from seven borehole locations on the riverbanks between RM 6.0 and RM 8.0. Thirteen Plexiglas tubes of soil were obtained from ten boreholes located in the river channel between RM 8.0 and RM 10.0. Table 1 shows the identity of each tube sample.

Figure 1. Location of the study area along the Lower American River.

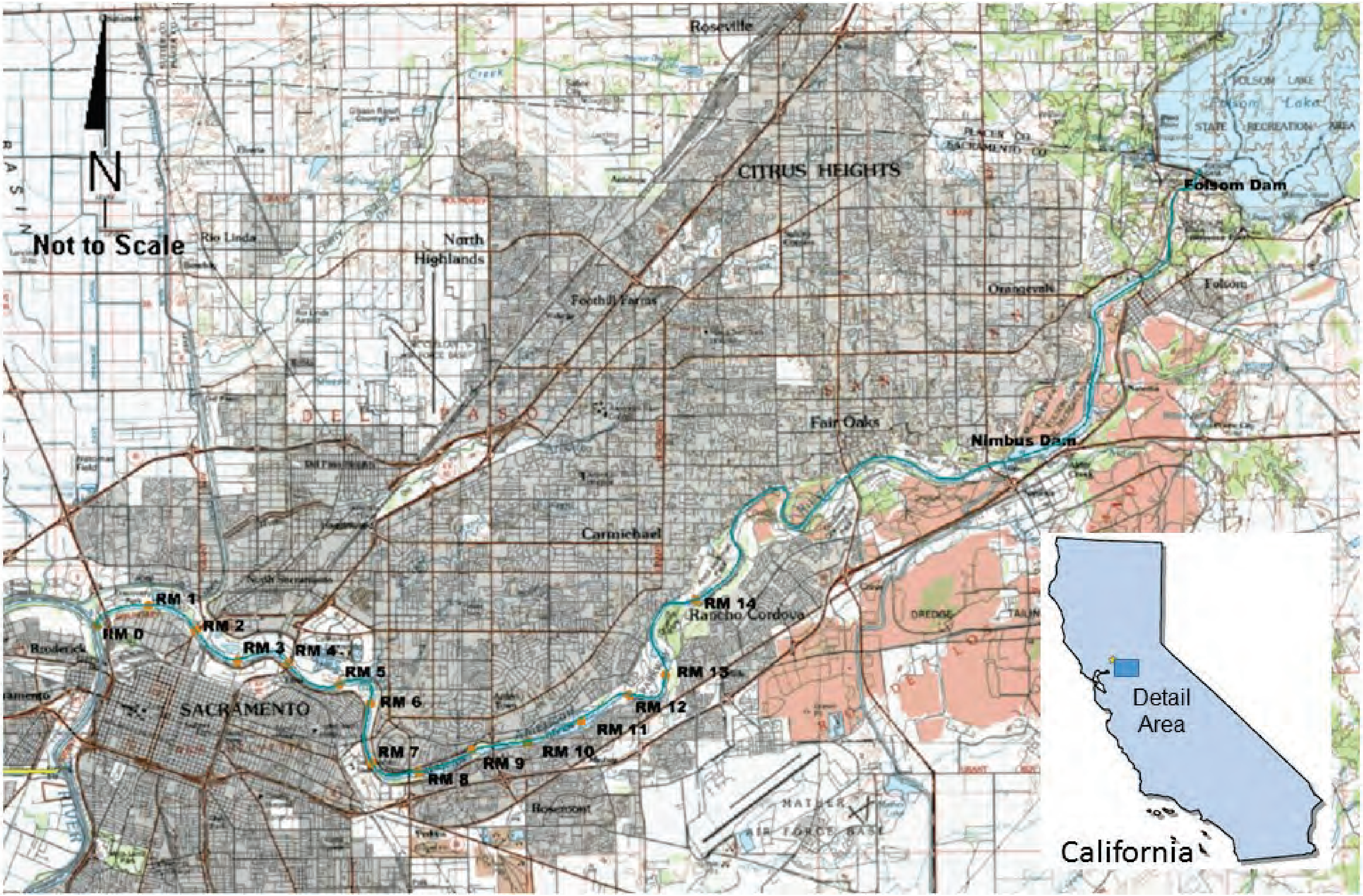


Figure 2. Boring locations between RM 6.0 and RM 10.0 used for laboratory JETs.

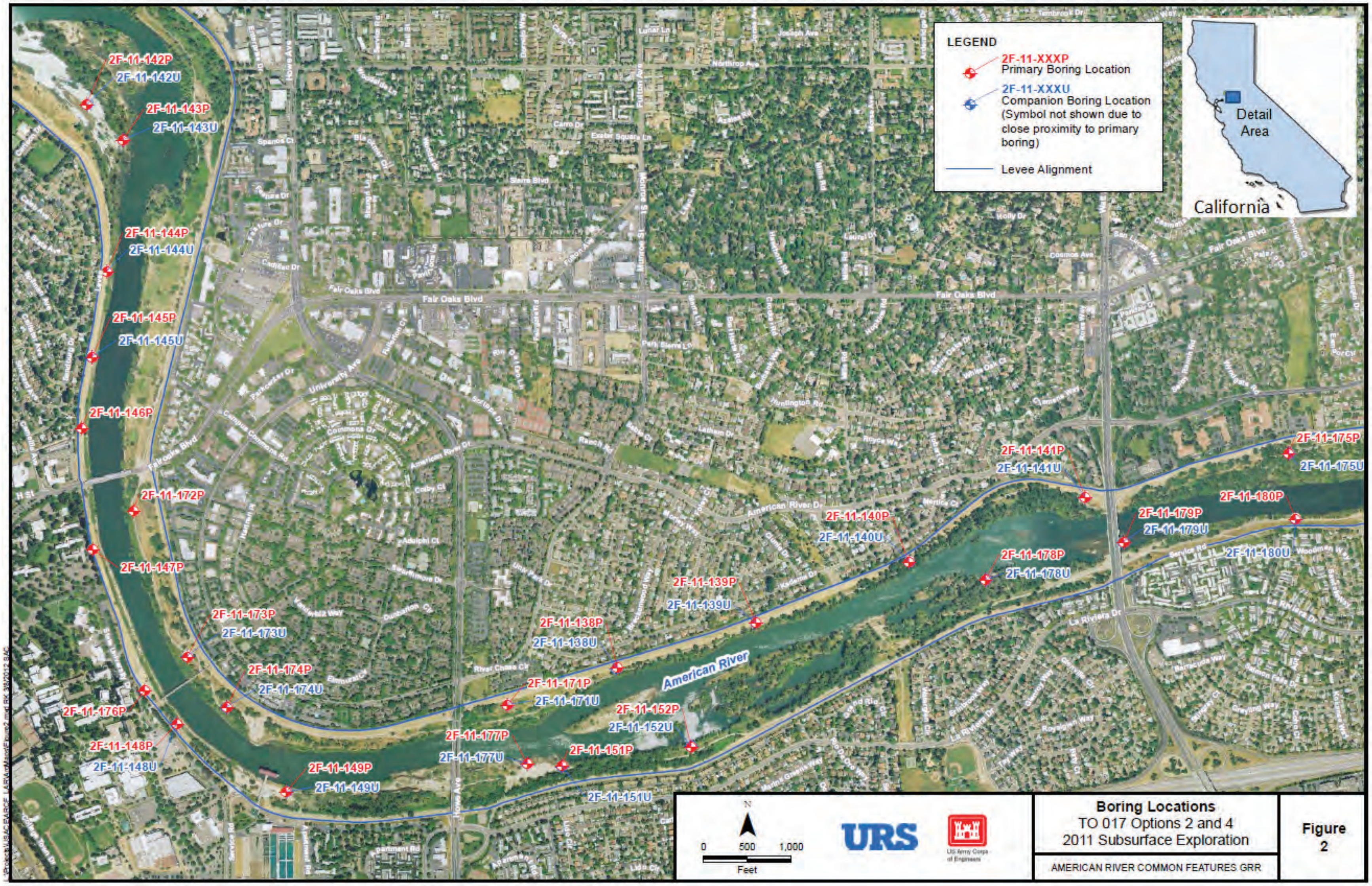


Table 1. Samples from borings at the Lower American River between RM 6.0 and RM 10.0.

Sample	Boring No.	Depth (ft)	Elevation (ft)	Tube No.	Sampling Date (month/day/yr)	Sample Type
1	2F-11-138U	25.0 – 27.0	38.7	T – 1	10 – 10 – 11	Plexiglas Tube
2	2F-11-138U	49.0 – 51.0	38.7	T – 4	10 – 09 – 11	Plexiglas Tube
3	2F-11-139U	46.0 – 48.0	38.5	T – 4	10 – 07 – 11	Plexiglas Tube
4	2F-11-141U	25.0 – 27.0	49.5	T – 1	10 – 17 – 11	Plexiglas Tube
5	2F-11-142U	35.0 – 37.0	19.3	T – 3	10 – 17 – 11	Plexiglas Tube
6	2F-11-143U	33.0 – 35.0	20.6	T – 3	10 – 04 – 11	Plexiglas Tube
7	2F-11-144U	46.0 – 48.0	39.0	T – 1	10 – 04 – 11	Plexiglas Tube
8	2F-11-145U	48.0 – 50.0	39.8	T – 2	10 – 18 – 11	Plexiglas Tube
9	2F-11-148U	36.0 – 38.0	40.9	T – 3	10 – 18 – 11	Plexiglas Tube
10	2F-11-151U	26.0 – 28.0	23.3	T – 2	10 – 14 – 11	Plexiglas Tube
11	2F-11-152U	25.0 – 27.0	29.2	T – 2	10 – 19 – 11	Plexiglas Tube
12	2F-11-173U	37.0 – 39.0	37.9	T – 1	09 – 28 – 11	Plexiglas Tube
13	2F-11-173U	43.0 – 45.0	37.9	T – 4	09 – 29 – 11	Plexiglas Tube
14	2F-11-174U	37.0 – 39.0	36.2	T – 2	09 – 30 – 11	Plexiglas Tube
15	2F-11-174U	44.0 – 46.0	36.2	T – 4	09 – 30 – 11	Plexiglas Tube
16	2F-11-175U	46.0 – 48.0	45.9	T – 2	09 – 26 – 11	Plexiglas Tube
17	2F-11-175U	48.0 – 50.0	45.9	T – 3	10 – 21 – 11	Plexiglas Tube
18	2F-11-177U	33.0 – 35.0	23.7	T – 3	10 – 21 – 11	Plexiglas Tube
19	2F-11-178U	14.0 – 16.0	23.4	T – 2	10 – 21 – 11	Plexiglas Tube
20	2F-11-179U	13.0 – 15.0	22.2	T – 1	10 – 21 – 11	Plexiglas Tube
21	2F-11-179U	24.0 – 26.0	22.2	T – 4	10 – 21 – 11	Plexiglas Tube
22	2F-11-180U	26.0 – 28.0	37.8	T – 2	10 – 21 – 11	Plexiglas Tube

2 Jet Erosion Test Theory and Background

The generally accepted mathematical representation of erosion phenomena can be found in the literature (Hutchinson 1972; Hanson 1991; Stein and Nett 1997; Hanson and Cook 2004) as

$$\varepsilon = k_d\left(\tau_e - \tau_c\right)^a \tag{1}$$

where

k_d = erodibility coefficient (m^3/N-s)
τ_e = effective hydraulic stress (Pa)
τ_c = critical stress (Pa)
a = material specific exponent (typically assumed equal to 1)

The equation describes the physical phenomena of erosion and states that the rate of erosion is proportional to the difference in effective hydraulic shear stress and critical stress.

Hanson (1991) initiated the development of an erosion testing apparatus for various geologic materials, as shown schematically in Figure 3. The test is based on the concept that the depth of erosion in erodible material varies as a function of the applied hydraulic stress and time. The higher the applied stress, the faster the material will erode to a state of equilibrium. The details of the original procedure are described in ASTM Standard D5852-07 (ASTM 2007). As an enhancement to the procedure, Hanson and Cook (2004) removed the empiricism from the data reduction process by incorporating the work by Stein and Nett (1997), which computes the applied shear stress based on the diffusion principal of a submerged circular jet. Using this modified procedure, the initial shear stress is then expressed as

$$\boldsymbol{\tau}_i = \boldsymbol{\tau}_o\left(\frac{\boldsymbol{J}_p}{\boldsymbol{J}_i}\right)^2 \tag{2}$$

$$J_p = C_d d_0 \tag{3}$$

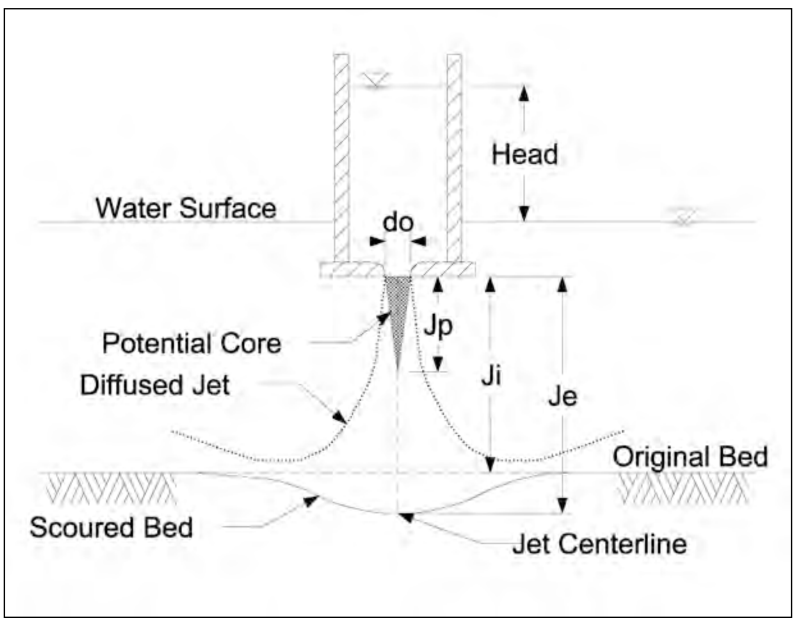
$$\tau_0 = C_f \rho U_0^2 \tag{4}$$

$$U_0 = \sqrt{2gh} \tag{5}$$

where:

τ_i = initial shear stress before scour
τ_0 = maximum stress within potential core
J_p = potential core length
J_e = equilibrium erosion depth
C_d = diffusion constant = 6.3
d_0 = nozzle diameter
C_f = friction coefficient
ρ = fluid density
U_0 = velocity at the jet nozzle
g = acceleration due to gravity
h = differential head.

Figure 3. Schematic diagram of the jet erosion process (after Hanson and Cook 2004).



To calculate the equilibrium scour depth, Hanson and Cook used the expression proposed by Blaisdell et al. (1981) that assumes the scour rate conforms to a logarithmic hyperbolic function. The critical stress parameter τ_c is predetermined by fitting the observed scour data to this logarithmic hyperbolic curve. Once the critical stress is computed using equations (2) through (5), the erodibility coefficient k_d is then determined by curve fitting the actual measurement of scour depth (H) versus time (t) to a

nondimensionalized form of equation (1). The detailed discussion of this procedure can be found in Hanson and Cook (1999, 2004).

The laboratory JET apparatus consists of a constant pressure source and the jet erosion testing unit. The constant pressure supply consists of a 500-gal water reservoir, a 2-HP electric pump, 2-in.-diam inlet and outlet hoses, and a manifold for controlling the assigned pressure. The jet erosion testing unit consists of a 12-in.-diam by 12-in.-high Plexiglas chamber that holds the specimen. A circular aluminum plate is placed on the top of the chamber to hold the pressure jet tube in place directly over the specimen. The digital pressure gage, or manometer gage, is placed in this pressure jet tube. It is assumed that the pressure of water in the tube is the same as the pressure at the mouth of the 0.25-in.-diam orifice located at the bottom of the pressure jet tube. The erosion measurement was performed using a 0.25-in.-diam manual point gage, which was extended to the soil surface through the pressure orifice. A movable deflector was placed 2 in. underneath the orifice to protect the sample by deflecting the pressure jet of water between pressure adjustments (on versus off). At the center of the chamber base, there is a 4-in.-diam circular groove that keeps the sample tube in place during the testing. The entire apparatus is shown in Figure 4, and a close-up view of the Plexiglas JET unit is shown in Figure 5. A more detailed explanation of the apparatus can be found in Hanson and Cook (2004).

Figure 4. ERDC laboratory JET apparatus.

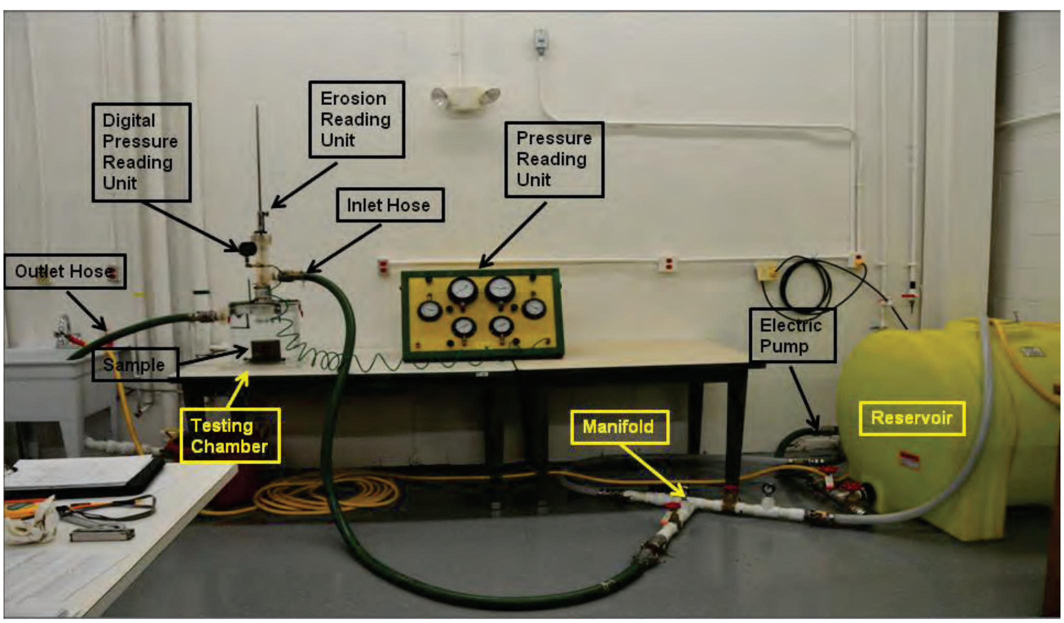
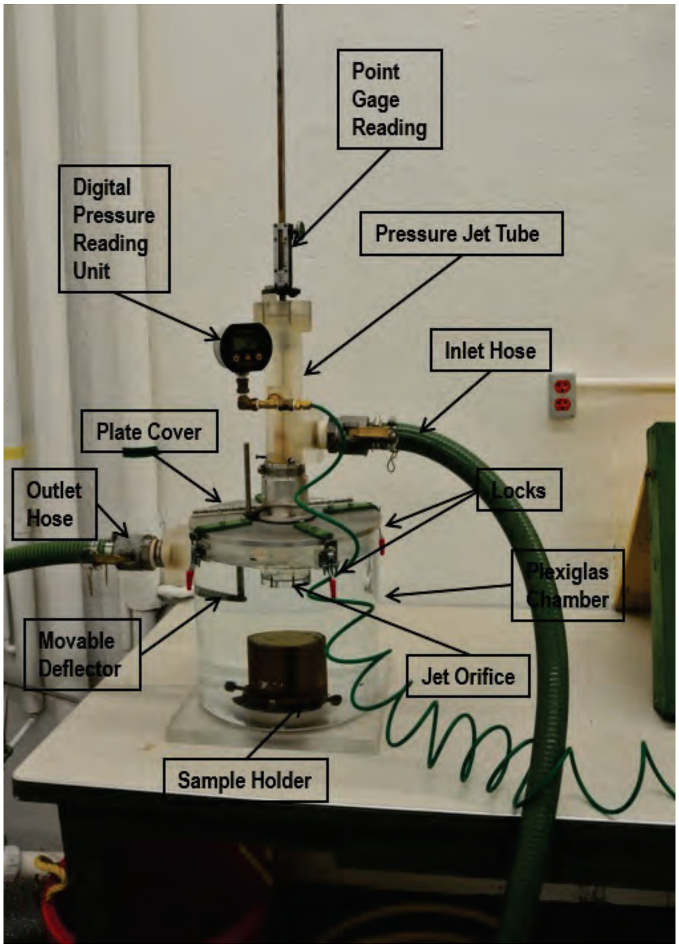
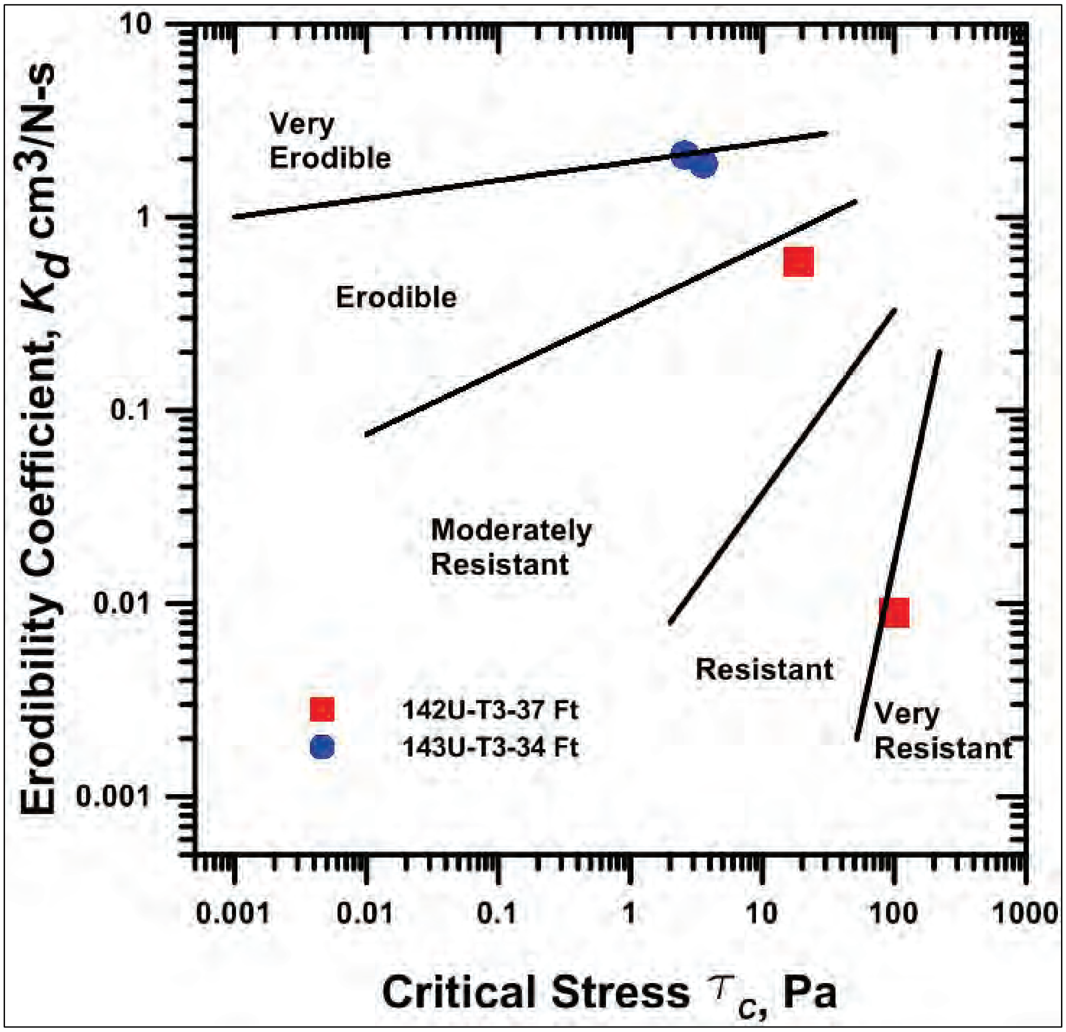


Figure 5. Details of erosion chamber.



Hanson and Simon (2001) developed an erosion susceptibility classification for geologic material. The classification uses five groups with regard to erosion resistance (Figure 6). The five groups are Very Erodible (VE), Erodible (E), Moderately Resistant (MR), Resistant (R), and Very Resistant (VR).

Figure 6. Hanson and Simon (2001) erosion criteria.



3 Testing Procedures and Sample Preparation

The undisturbed samples from LAR were obtained in 4-in.-diam Plexiglas tubes (Figure 7) collected with a Pitcher Tube sampler from continuous borings performed by Westex R&M Drilling Company. In the past, JETs were performed as an in situ test or on 4-in.-diam compacted samples in the laboratory. The Plexiglas tubes were cut using a grinder, as shown in Figure 8. The cutting process was conducted carefully and slowly to minimize additional sample disturbance. After removal of the wax seal at the ends of the tubes, photographs were taken to record any initial sample disturbance.

The tubes were cut to provide a 4- to 4.5-in. vertical sample for JETs, and water content samples were obtained from the exposed soil at the cut. The cut samples were weighed and photographed prior to undergoing JETs. The sample was positioned and clamped to the base of the test chamber with a setscrew, the circular plate was fastened to the top of the chamber, and the test procedures were initiated. An initial point gage reading was obtained to record the position of the orifice relative to the soil surface. The deflector plate was then positioned and the chamber filled with water. Once the chamber was full of water, the manifold valve was adjusted to the desired initial pressures, the deflector plate was opened, and the water jet was allowed to impinge on the soil surface. At the assigned time for the first interval (30 sec or 1 min), the deflector was placed in front of the water jet, and the manifold was closed, resulting in zero pressure. The point gage rod was lowered to measure the new soil surface elevation after the first round of erosion, and the first JET data point was recorded. The point gage rod was then raised, the deflector plate was positioned in front of the water jet, and the pressure was increased back to the assigned value. This process was repeated until the amount of erosion began to asymptotically approach a constant value. If the amount of erosion induced by the JET was found to be insignificant, the pressure could be increased, indicating that the critical shear stress of the material was not exceeded by the initial pressure chosen. For a given test, 8 to 10 data points are required to provide a reasonable data set for curve fitting. After the completion of a test, the valve was shut, the JET apparatus was opened, and the sample was carefully removed for a post-test photograph. Figures 7 through 12 show steps taken sequentially through the process described, from the Plexiglas tube sample to the JET.

Figure 7. Plexiglas tube with soil sample.

Figure 8. Using grinder to cut Plexiglas tube.

Figure 9. Specimen before testing was performed.

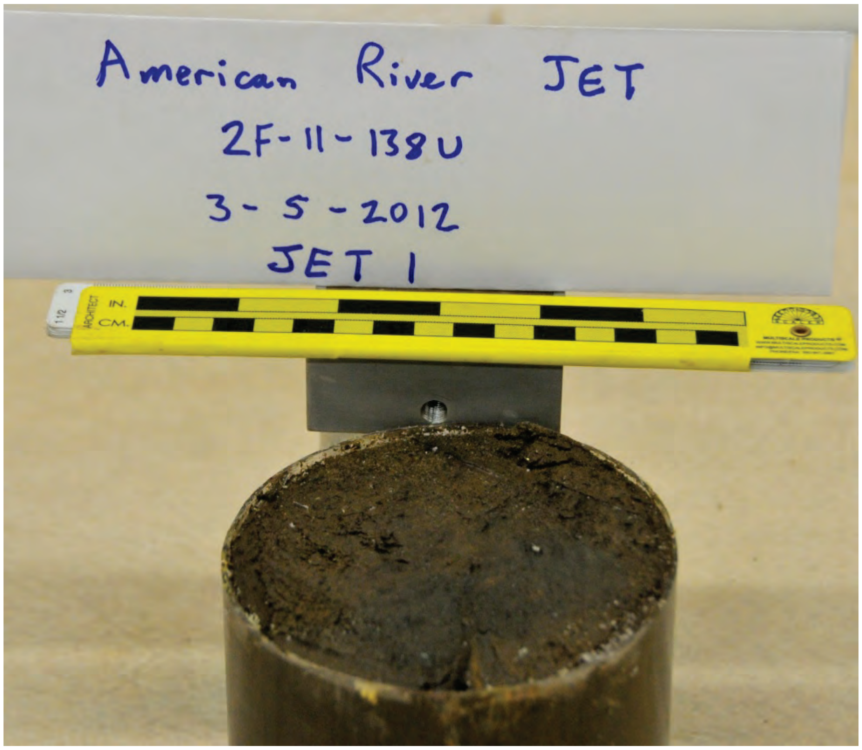
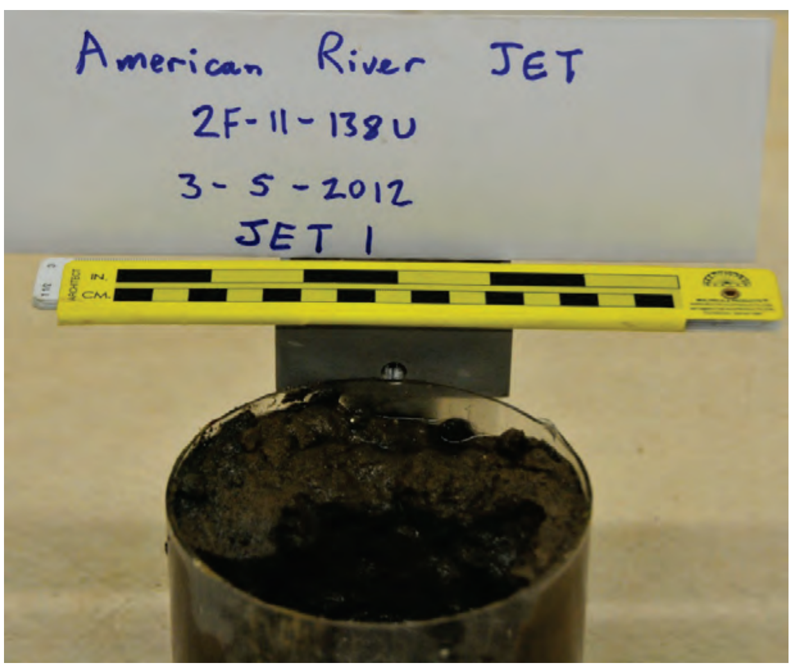


Figure 10. Specimen inside the chamber, ready for JET.

Figure 11. JET in progress.

Figure 12. Specimen after testing.



4 Test Results/Discussions

The resulting JET measurements of a sample from Boring 138, Tube 1, JET 1 at approximately 27 ft below the riverbed are shown in Figure 13. The soil sample was tan and gray, uncemented silty-fine sand. The test was performed under 0.5 -psi pressures with 5-sec reading intervals at the beginning. The erosion progressed rapidly and, after about 5 min, the accumulated erosion was about 3.8 cm. The test was terminated with 13 data points. This is typical of a good data record for soft soil.

Figure 13. JET data of sample from Boring 138 Tube 1, JET 1.

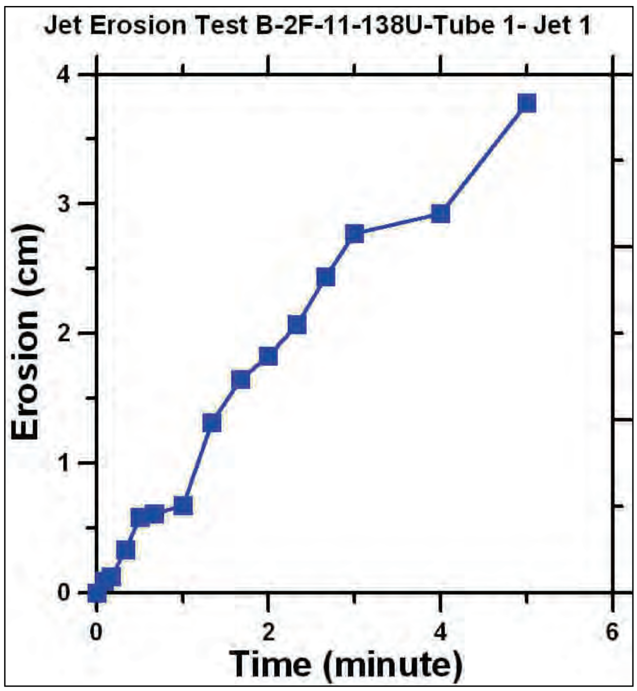


Figure 14 shows a hyperbolic fit of the erosion data from Boring 138, Tube 1, JET-1. The data points closely match with the hyperbolic equation. This plot was used to calculate the value of equilibrium erosion depth, $J_e J_E$, which was then used to calculate the critical stress τ_c using Equation 2. Figure 15 shows the data fit to the dimensionless form of the scour function (Equation 1). The dimensionless time and depth fit were used for calculating the value of the erosion coefficient K_d. The value of erodibility coefficient computed was 52.08 cm^3/N-s, and the computed value of critical shear stress was 0.865 Pa. As will be discussed later, this sample was categorized as VE material.

Figure 14. Logaritmic hyperbolic curve fit analysis for finding the equilibrium erosion depth of sample from Boring 138 Tube 1, JET 1.

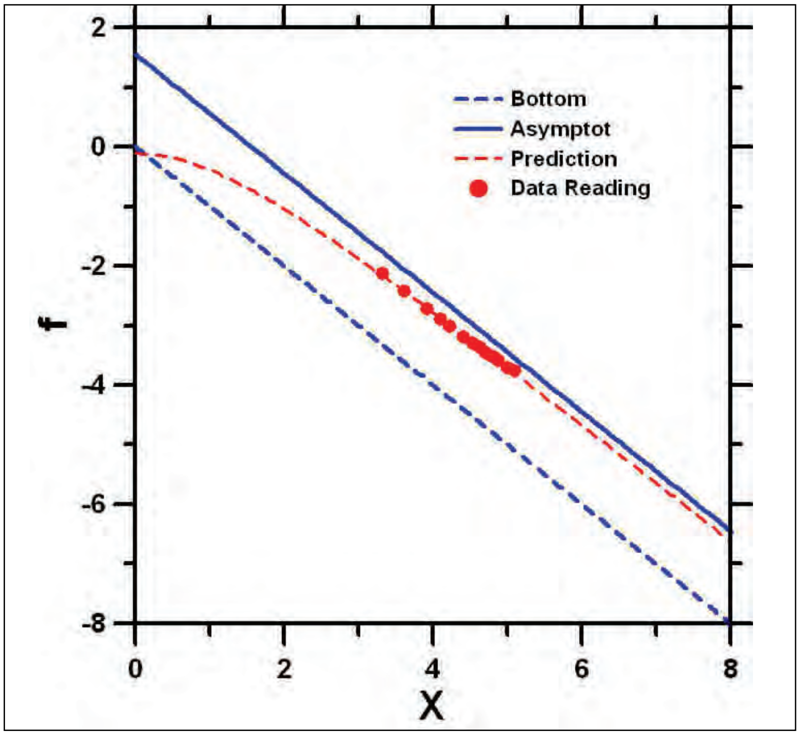
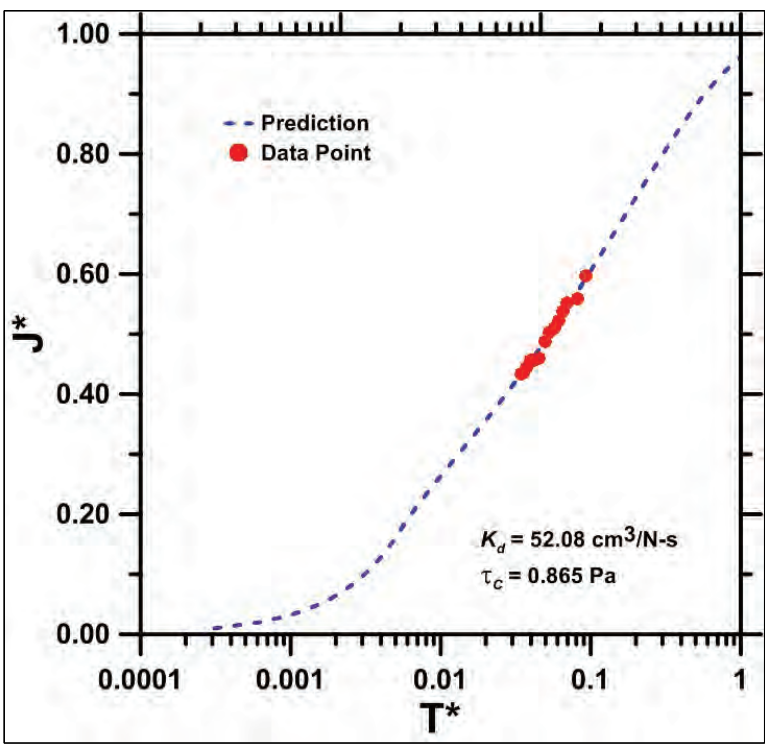
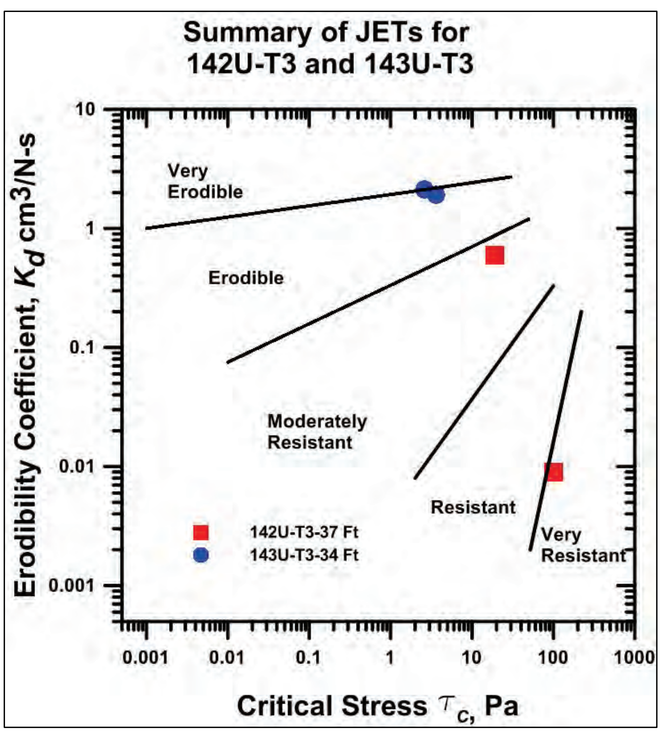


Figure 15. Dimensionless scour function for finding the erosion coefficient of sample from Boring 138 Tube 1, JET 1.



The JET results are presented into seven groups based on the borehole locations along the Lower American River. The first group of summarized JET results for two Plexiglas tubes from the left bank of the LAR at approximately RM 5.7 is shown in Figure 16. The results are from Boring 142U-T3 at a depth of about 37 ft and from Boring 143U-T3 at a depth of about 34 ft. Both samples have an approximate elevation of between -17 to -18 ft, as referenced to the North American Vertical Datum of 1988 (NAVD8), while the elevation of the Erosion Resistant Surface (ERS) is about -7 ft (Fugro, 2012). Both samples are below the ERS, which theoretically means they should be erosion resistant. The results obtained for samples from 142U-T3 agree well with the location of the ERS and are considered to be very erosion resistant. However, the samples from 143U-T3 were considered to be erodible. ERDC performed two JETs for each tube, but sometimes multiple erosion values may be extracted from one JET due to changes in soil properties, provided multiple readings in a single soil layer are obtained. Figure 16 also shows the erosion categories proposed by Hanson and Simon (2001). Observing the data from Boring 142-Tube 3, the soil falls into two different categories: VR and MR. The soils from B-142-T3 are not homogeneous. This may be because riverbeds are usually nonhomogeneous. The specimens tested from B-143-T3 are categorized as E to VE.

Figure 16. Summary of test data of boring at the left bank of the LAR at RM 5.7.



The second group of summarized JET results for two Plexiglas tubes from two boreholes on the left bank of the LAR at RM 6.0 is shown in Figure 17. The results are for Boring 144U-Tube 1 and Boring 145U-Tube 2. The sample depths range from 47 to 50 ft below the ground surface. The elevations of both samples are approximately -8.4 to -10.5 ft. Considering that the ERS elevations range from -6.0 to -8.0 ft, both samples are below the ERS, which should be Erosion Resistant. Figure 17 shows that both specimens from Boring 144U-T1 are VR. One specimen from Boring 145U-T2 exhibited VR behavior, while the other specimen was slightly less resistant (MR).

The third group of JETs is for five Plexiglas tubes from three boreholes that were obtained from both sides of the LAR at approximately RM 7.1. The results are shown in Figure 18.

The results shown are from borings 148U-Tube 3, 174U-Tube 2 and Tube 4, and 173U-Tube 1 and Tube 4. The sample depths ranged from 38 to 46 ft below the riverbed. Based on the data from Boring 148U-Tube 3, the soil classified into two different categories: E and VR.

Figure 17. Summary of test data of boring at the left bank of the LAR at RM 6.0.

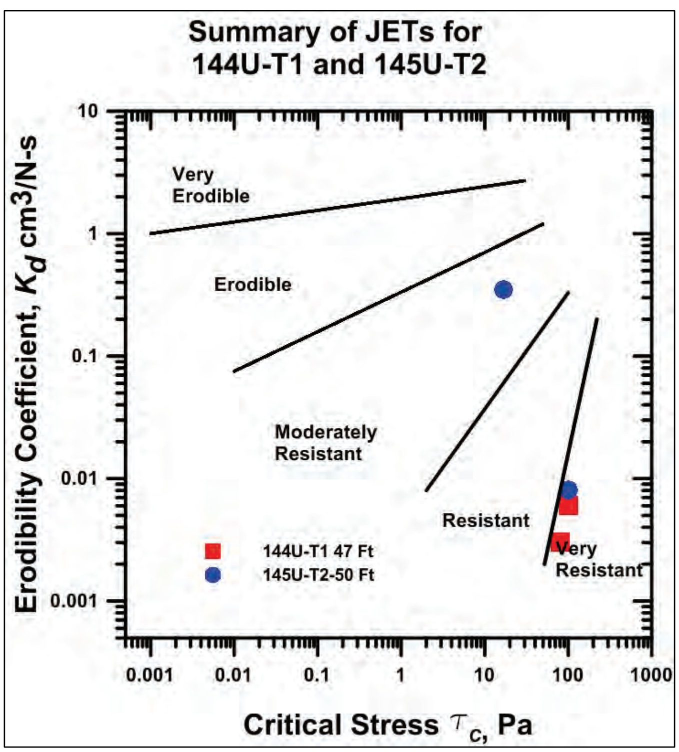
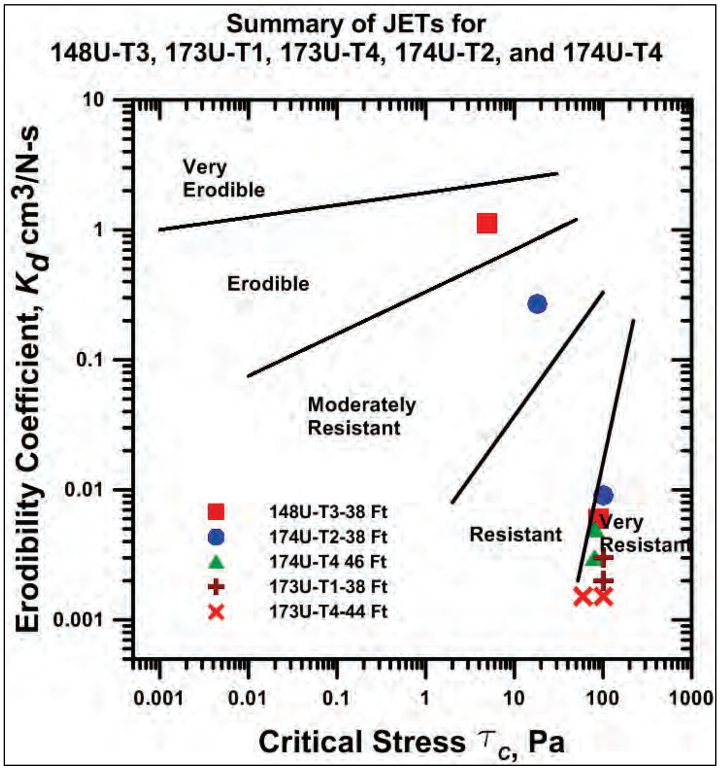


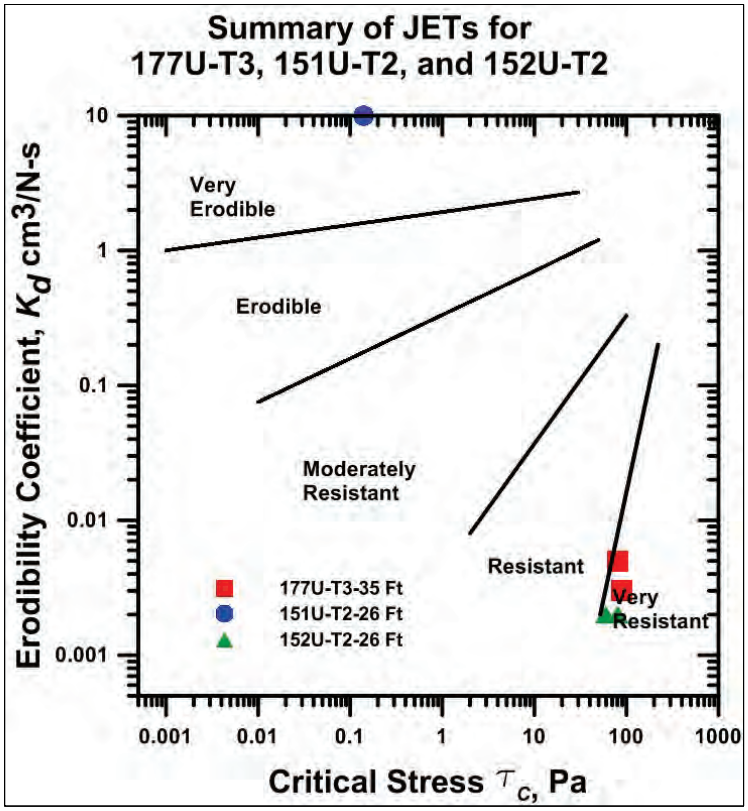
Figure 18. Summary of test data of boring at both banks of the LAR at RM 7.1.



Because this tube was obtained from approximately 5 ft below the ERS, it is likely the specimen was disturbed by the sampling process and/or test preparation. The soils from B173U-T1 and T4 were both from above the ERS, but the four specimens showed VR behavior. The soil from B174U-T2 was from below the ERS and exhibited two resistance levels: MR and VR. The soils from Boring B174U-T4 were also from below the ERS and exhibited strong resistance against erosion and categorized as VR.

The fourth group of JET results obtained from three Plexiglas tube samples obtained from two boreholes in the left bank of the LAR between RM 8.0 and 8.3, near Howe Avenue Bridge, is shown in Figure 19. The results are for Borings 177U-Tube 3, 151U-Tube 2, and 152U-Tube 2. The sample depths ranged from 26 to 35 ft below the riverbed. The sample from Boring 177U-Tube 3 was approximately 11 ft below the suggested ERS, and both specimens were categorized as VR. The sample from Boring 151U-Tube 2 was located just above the suggested ERS. The entire specimen was eroded in 3 min under 1 psi pressure. This soil was categorized as VE. The sample from Boring 152U-T2 was located approximately 10 ft below the ERS and was found to be VR against erosion.

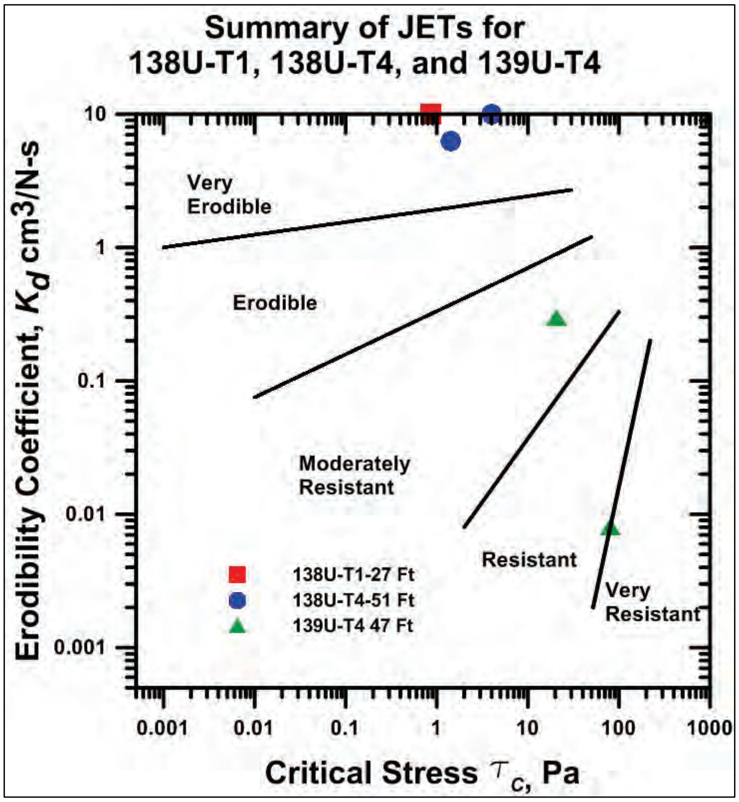
Figure 19. Summary of test data of boring from left bank of the LAR between RM 8.0 and 8.3.



The fifth group of summarized JET results is from three sample tubes from two boreholes in the right bank of the LAR between RM 8.2 and 8.5, between Howe Avenue and Watt Avenue bridges. The results are shown in Figure 20. The results are for borings 138U-Tube 1, 138U-Tube 4, and 139U-Tube 4.

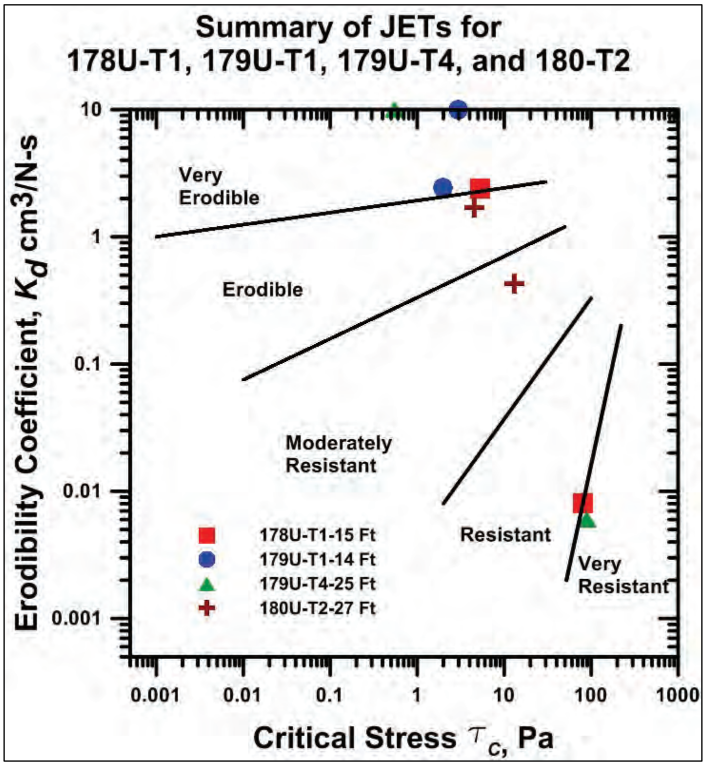
The sample depths ranged from 27 to 50 ft, and elevations ranged from -11.0 to -12 ft. Observing the data from Boring 138U-Tube 1, the soil was approximately 16 ft above the suggested ERS, and the specimens were categorized as VE. The soils from Boring 138U-Tube 4 were obtained from approximately 7 ft below the ERS. Both specimens exhibited a blocky type of erosion. It is highly likely that the sampling process caused fracturing of the specimen that resulted in this blocky erosion. The erosion test results categorized the soil as VE. The sample from Boring 139U-T4 was obtained from approximately 11 ft below the ERS and was categorized as MR and VR.

Figure 20. Summary of test data of boring from right bank of the LAR between RM 8.2 and 8.5.



The sixth group of summarized JET results from four Plexiglas tubes from three boreholes in the left bank of the LAR between RM 9.2 and 9.6, at Watt Avenue Bridge, is shown in Figure 21. The results are for borings 178U-Tube 1, 179U-Tube 1, 179U-Tube 4, and 180U-Tube 2. Sample depths ranged from 14 to 18 ft and elevations ranged from -4.0 to 10.0 ft. Observing the data from Boring 178U-Tube 1, the soil was from approximately 5 ft above the suggested ERS, and the test specimens were categorized as E, VE, and VR. The soils from Boring 179U-Tube 1 were obtained from approximately 6 ft above the ERS, and both specimens were categorized as VE. The sample from Boring 179U-T4 was taken from approximately 6 ft below the ERS. It was found that one test specimen was VR, while the other specimen was VE. The sample from Boring 180U-T2 was obtained from approximately 7 ft below the ERS, the two test specimens were classified as E and MR.

Figure 21. Summary of test data of boring from right bank of the LAR between RM 9.2 and RM 9.6.



The seventh group of summarized JET results from two sample tubes from two boreholes in the left bank of the LAR at RM 9.6 is shown in Figure 22. The results are for borings 175U-Tube 2 and 175U-Tube 3. The sample depths ranged from 47 to 49 ft below the riverbed. According to the data from Boring 175U-Tube 2, researchers determined that the soil was approximately 20 ft below the suggested ERS, but the specimen was soft, silty, fine-to-medium sand. Both specimens showed no resistance against erosion and were categorized as VE. The other soils from the same boring (Tube 3, located 22 ft below the ERS and 2 ft deeper than the previous sample) exhibited much more resistance to erosion and were categorized as VR. A complete listing of values of erosion resistance of all seven groups is in Table 2 and is also shown in Figure 23 along with the groups' locations. All erosion data, along with photographs of specimens before and after JETs, are in Appendix A. Laboratory soil property data are in Appendix B.

Figure 22. Summary of test data of boring from right bank of the LAR between RM 9.6.

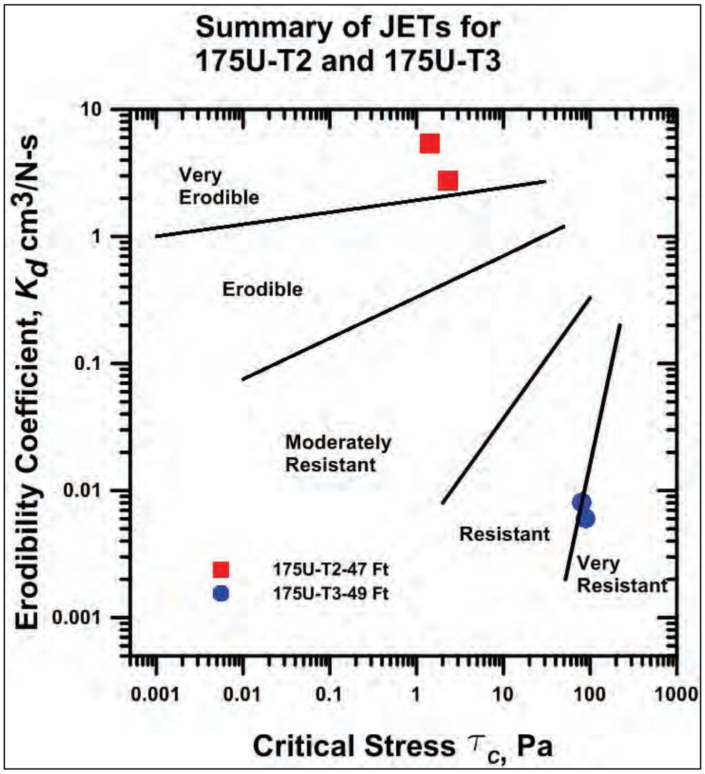


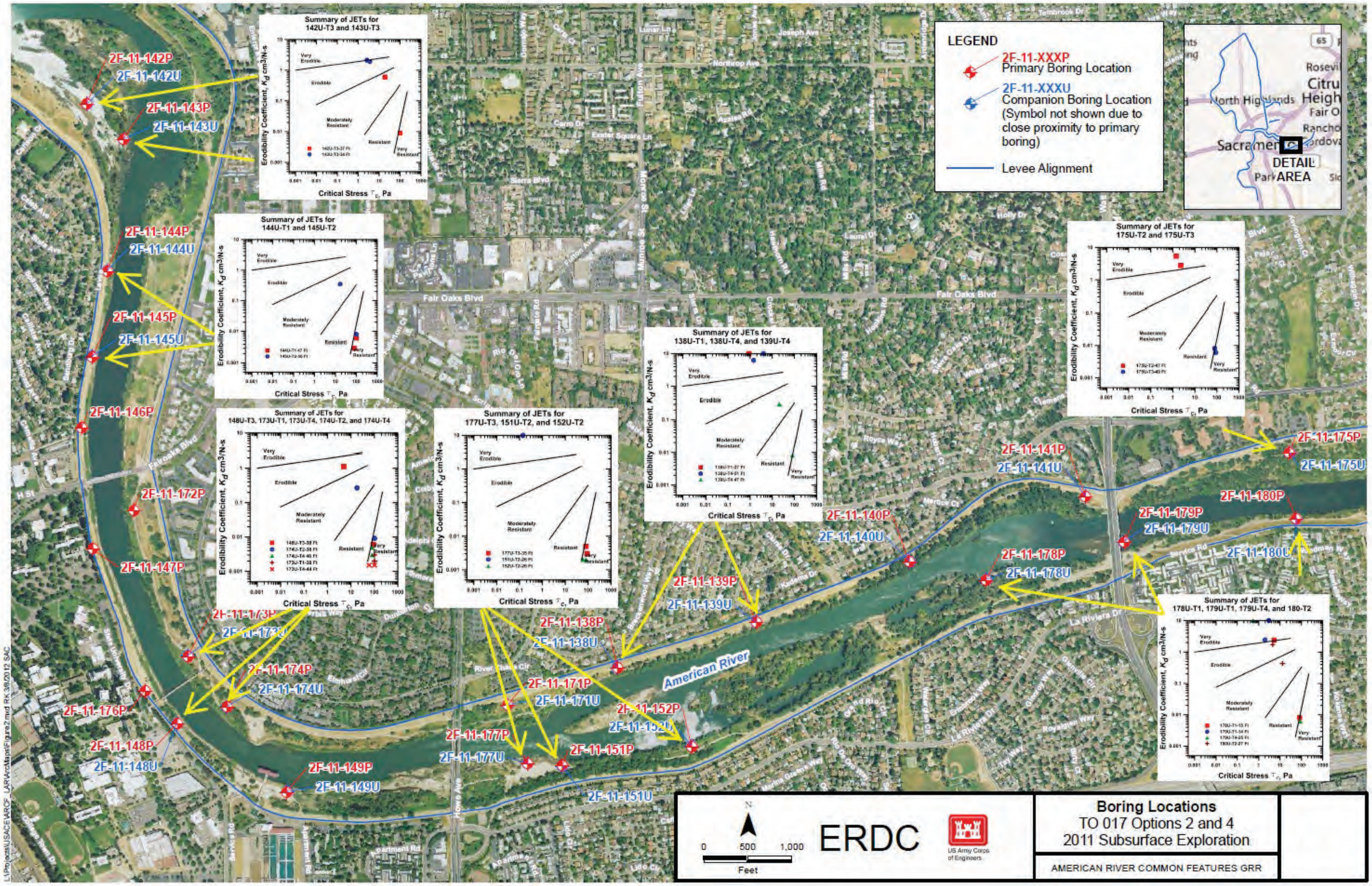
Table 2. Summary of JETs of LAR soil sample, Sacramento District.

Boring & Test #	Depth, ft	Soil Type	τ_c Pa	k_d cm^3/N-s	Erosion Depth, cm	Time, min	Category	Pressure, kPa (Psi)
2F-11-138U-Tube-1 Jet # 1	27	Loose, stratified SM	0.865	52.075	3.78	5	VE	3.5(0.5)
2F-11-138U-Tube-4 Jet # 1	50.5	Med stiff ML	1.441	6.251	4.67	36	VE	6.9 (1)
2F-11-138U-Tube-4 Jet # 2	50.1	Wet, soft, sandy clay ML	3.984	10.696	2.35	22	VE	13.8 (2)
2F-11-139U-Tube-4 Jet # 1	47.7	Stiff ML	20.55	0.296	0.34	60	MR	34.5 (5)
2F-11-139U-Tube-4 Jet # 2	47.3	Stiff ML	VR	VR	0.06	33	VR	34.5 (5)
2F-11-141U-Tube-1 Jet # 1	25.5	Silty sand/clay ML	3.86	4.444	1.59	47	VE	6.9 (1)
2F-11-141U-Tube-1 Jet # 2	25.0	Silt/sandy clay ML	1.60	8.779	4.91	53	VE	6.9 (1)
2F-11-142U-Tube-3 Jet # 1	37	Med stiff clay ML	VR	VR	0.03	53	VR	34.5 (5)
2F-11-142U-Tube-3 Jet # 2	36.3	Hard, very cemented sand ML	18.90	0.588	0.73	52	MR	34.5 (5)
2F-11-143U-Tube-3 Jet # 1	34.7	SM/ML	2.58	2.105	5.64	49	VE	20.7(3)
2F-11-143U-Tube-3 Jet # 2	34.3	SM/ML	3.62	1.898	1.71	65.5	VE	6.9(1)
2F-11-144U-Tube-1 Jet # 1	47.7	Med stiff CL/ML	VR	VR	0.06	40	VR	34.5 (5)
2F-11-144U-Tube-1 Jet # 2	47.3	ML	VR	VR	0.03	28	MR	34.5 (5)
2F-11-145U-Tube-2 Jet # 1	50	ML with fine sand	VR	VR	0.70	67	VE	34.5 (5)
2F-11-145U-Tube-2 Jet # 2	49.3	Very stiff ML	16.77	0.348	0.70	77	MR	34.5 (5)
2F-11-148U-Tube-3 Jet # 1	38	Very stiff sandy clay CL/ML	VR	VR	VR	51	VR	34.5 (5)
2F-11-148U-Tube-3 Jet # 2	37.3	Stiff sandy clay CL/ML	4.92	1.130	2.20	69	E	34.5 (5)
2F-11-151U-Tube-2 Jet # 1	26	Soft sandy silt/highly fracture SM	0.14	71.867	7.63	3	VE	20.7(3)
2F-11-152U-Tube-2 Jet # 1	26.7	Very stiff silty clay ML	V-R	V-R	0.09	42.5	VR	27.3(4)
2F-11-152U-Tube-2 Jet # 2	26.3		VR	VR	0.09	72	VR	27.3(4)
2F-11-173U-Tube-1 Jet # 1	38.7	Very stiff ML with silt	V-R	V-R	0.03	60.5	VR	34.5 (5)
2F-11-173U-Tube-1 Jet # 2	38.3	Very stiff ML with fine sand	V-R	V-R	0.61	62	VR	34.5 (5)
2F-11-173U-Tube-4 Jet # 1	44.7	Very stiff ML	V-R	V-R	V-R	41	VR	34.5 (5)
2F-11-173U-Tube-4 Jet # 2	44.3	Very stiff ML	V-R	V-R	V-R	51	VR	34.5 (5)
2F-11-174U-Tube-2 Jet # 1	38.7	Very stiff ML with fine sand	V-R	V-R	VR	51	VR	34.5 (5)
2F-11-174U-Tube-2 Jet # 2	38.3		18.32	0.268	0.946	61	MR-VR	34.5 (5)
2F-11-174U-Tube-4 Jet # 1	46	Very stiff ML	VR	VR	0.0	40	VR	34.5 (5)
2F-11-174U-Tube-4 Jet # 2	45.6	Very stiff ML	V-R	V-R	0.061	35	VR	34.5 (5)

Boring & Test #	Depth, ft	Soil Type	τ_c Pa	k_d cm³/N-s	Erosion Depth, cm	Time, min	Category	Pressure, kPa (Psi)
2F-11-175U-Tube-2 Jet # 1	47.7	Soft-med silt with fine sand SM	1.41	5.420	10.31	40	VE	6.9 (1)
2F-11-175U-Tube-2 Jet # 2	47.3	Silty sand SM	2.29	2.728	2.29	67	VE	20.7(3)
2F-11-175U-Tube-3 Jet # 1	49.7	Stiff silt ML	V-R	V-R	VR	50	VR	34.5 (5)
2F-11-175U-Tube-3 Jet # 2	49.3	Stiff silt ML	V-R	V-R	0.09	73	VR	34.5 (5)
2F-11-177U-Tube-3 Jet # 1	34.7	Med stiff silt ML	V-R	V-R	0.31	21.5	VR	34.5 (5)
2F-11-177U-Tube-3 Jet # 2	34.3	Med stiff silt ML	VR	VR	2.17	68	MR-VR	34.5 (5)
2F-11-178U-Tube-1 Jet # 1	15.7	Fine sand ML?	5.24	2.367	1.281	57	VE	13.8 (2)
2F-11-178U-Tube-1 Jet # 2	15.3	Stiff fine grain sand ML?	V-R	V-R	0.031	102	VR	103.5 (15)
2F-11-179U-Tube-1 Jet # 1	14.7	Clayey silt with sand ML	1.96	2.442	2.56	54	VE	6.9 (1)
2F-11-179U-Tube-1 Jet # 2	14.3	Clayey silt with sand ML	2.93	10.399	2.10	20	VE	6.9 (1)
2F-11-179U-Tube-4 Jet # 1	26.0	Well cemented ML	V-R	V-R	0.03	155	VR	110.4 (16)
2F-11-179U-Tube-4 Jet # 2	25.6	Well cemented ML	0.55	26.773	5.09	9	VE	6.9 (1)
2F-11-180U-Tube-2 Jet # 1	27.7	Lightly cemented sandy silt ML	4.53	1.686	0.52	69	VE	6.9 (1)
2F-11-180U-Tube-2 Jet # 2	27.3	Lightly cemented sandy silt ML	13.19	0.428	1.25	72	MR	34.5 (5)

Note: V-E = Very Erodible, E = Erodible, M-R = Moderately Resistant, R = Resistant, V-R = Very Resistant, SM = Silty Sand, CL = Clay (low plasticity), ML = Silt.

Figure 23. Summary of all test data with boring locations.



5 Summary

Forty-two laboratory JETs were performed on undisturbed specimens from Plexiglas tube samples extracted from the LAR in Sacramento, CA. Visible disturbance had occurred for many of the hard, brittle samples, especially near the tube wall.

The variation in values of the measured erosion parameters may be caused by variation of the materials for some of the samples tested, (i.e., when material changed from silt/sand to clay). However, for many of the samples, the variation in results was due to changes in the quality of the sample. For many of the harder materials, the degree of fracturing that was present determined how much erosion would occur during a JET. Because of these observations, it is important that individual test details be taken into account for each test result. Material type, photographs, and testing notes must be taken into consideration when interpreting the test results for use in numerical models. By observing the sample disturbance that was present and the erosion progression behavior, the appropriate values of the erosion parameters can be chosen properly.

The erodibility of each sample was related to the ERS suggested by Fugro (2012) and URS-GEI (2012). Most of the specimens below the ERS could be categorized as MR to VR, although there were several anomalies due to interbedded silt/sand zones. Similarly, in general, the layer above the ERS could be categorized as VE to E, but some layers were VR.

The resulting values of the erosion coefficient, k_d, and critical stress, τ_c, are useful information in assessing the erodibility of riverbanks as well as the riverbed itself. Because of the natural variability of the observed materials, a combination of the erosion parameters presented in this report (along with the drilling logs and local geology) will be required to produce beneficial results for assessing the stability of the LAR.

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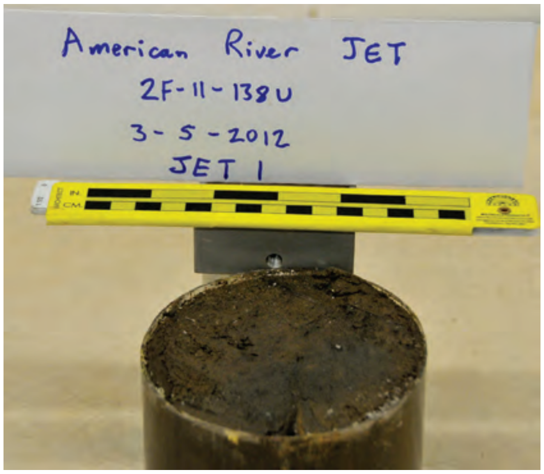
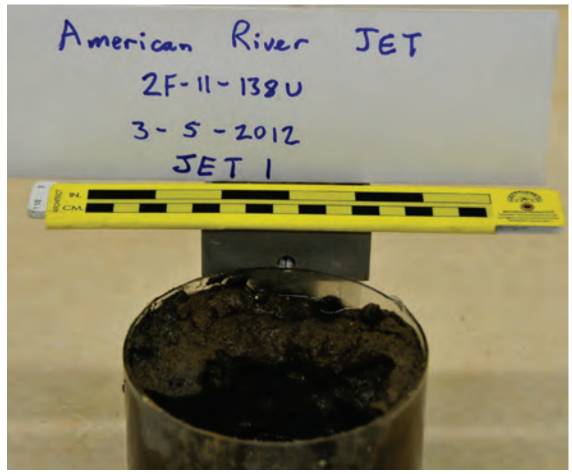
Appendix A: Erosion Data

Figure A1. Sample before and after JET with erosion data of Boring 138-U Tube-1 Jet-1.



Before JET



After JET

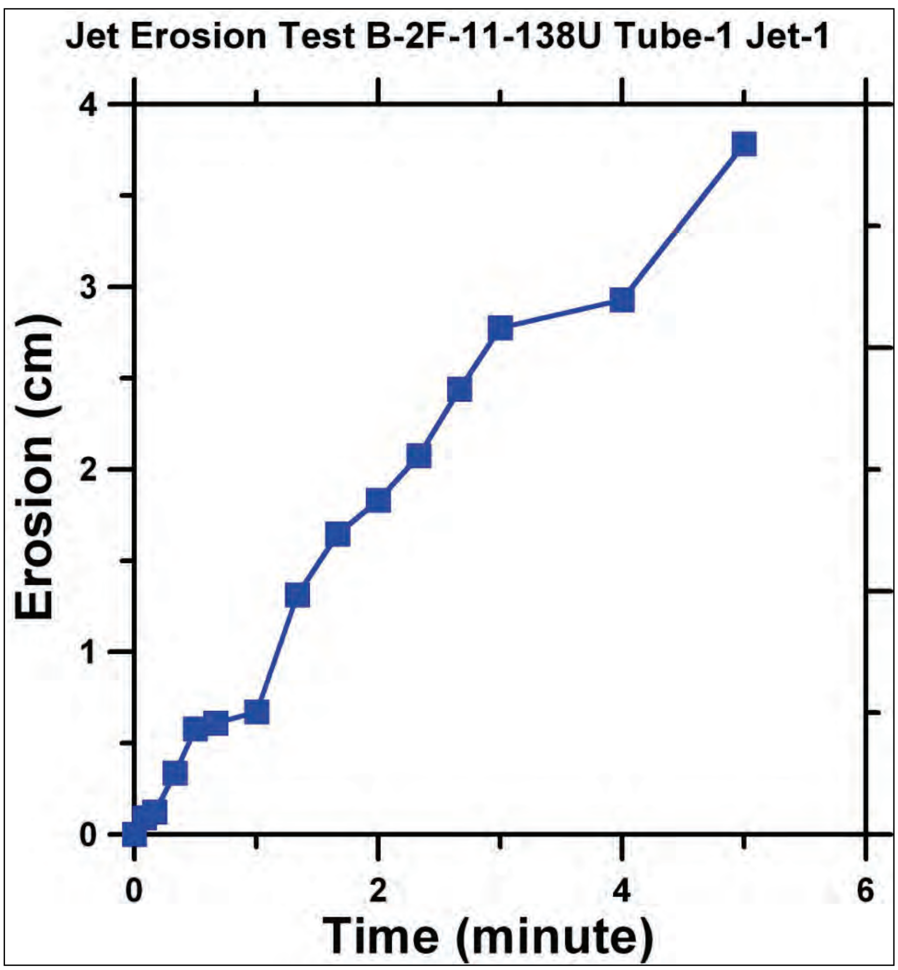


Figure A2. Sample before and after JET with erosion data of Boring 138-U Tube-4 Jet-1.

Before JET After JET

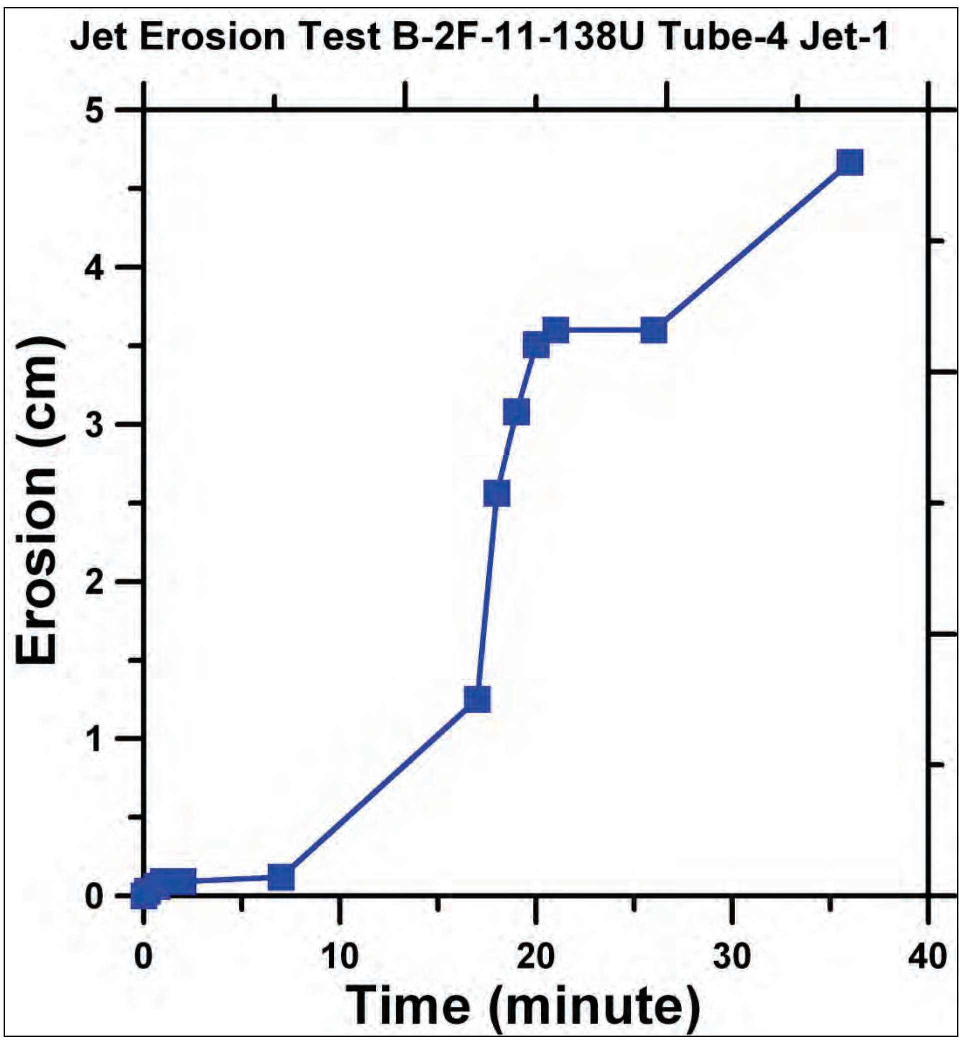


Figure A3. Sample before and after JET with erosion data of Boring 138-U Tube-4 Jet-2.

Before JET

After JET

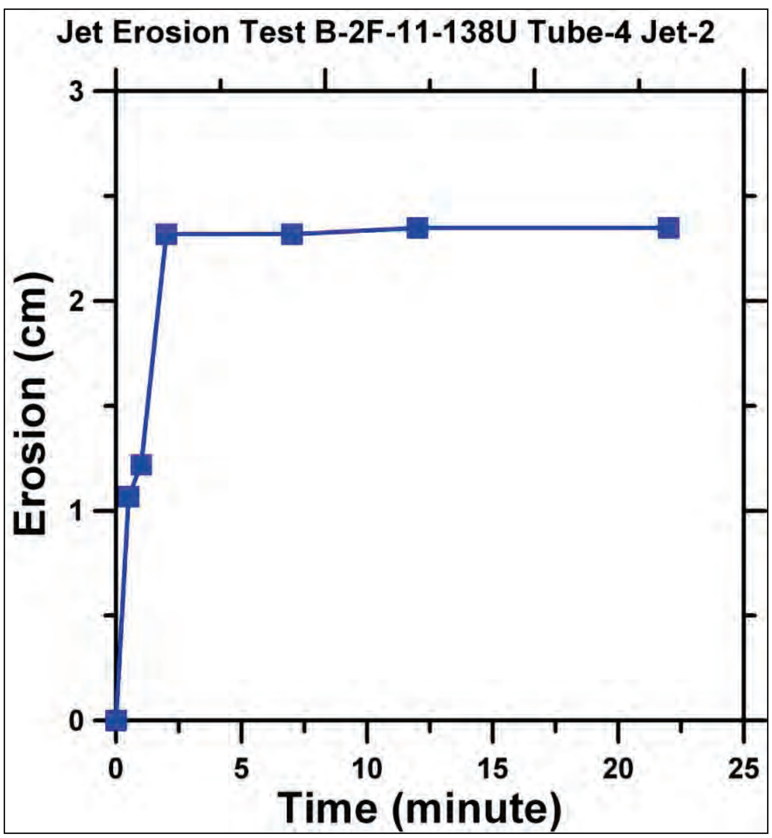


Figure A4. Sample before and after JET with erosion data of Boring 139-U Tube-4 Jet-1.

Before JET

After JET

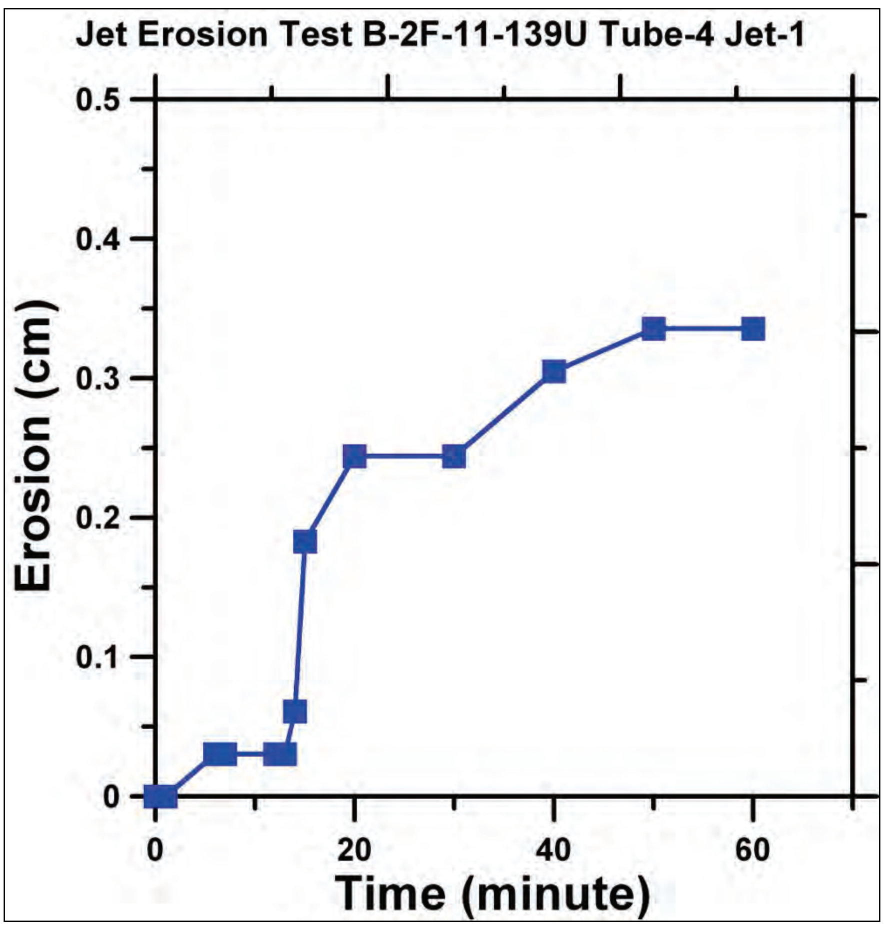


Figure A5. Sample before and after JET with erosion data of Boring 139-U Tube-4 Jet-2.

Before JET

After JET

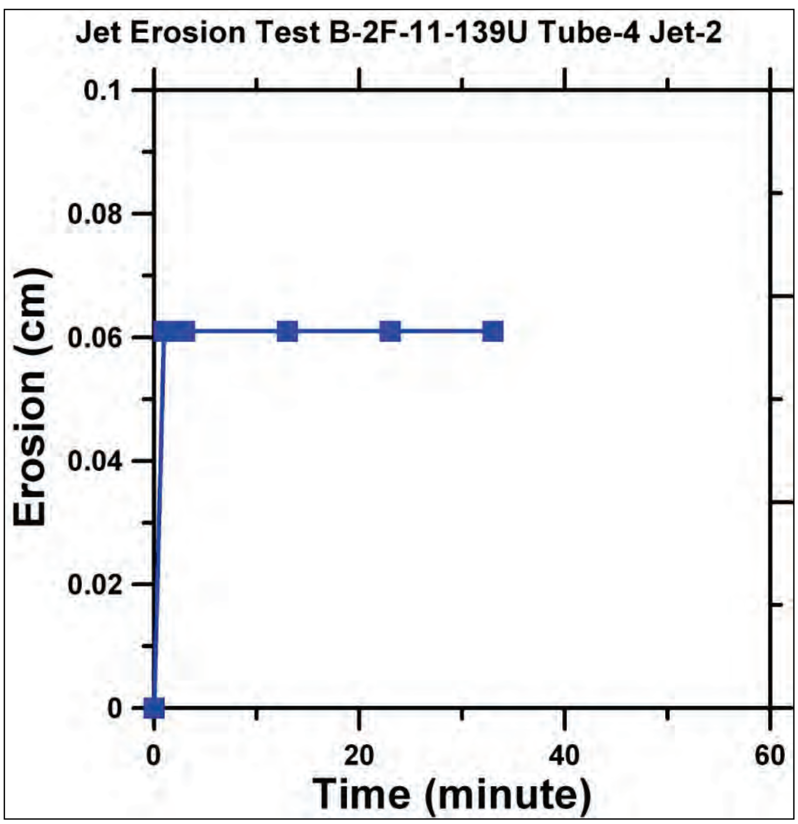
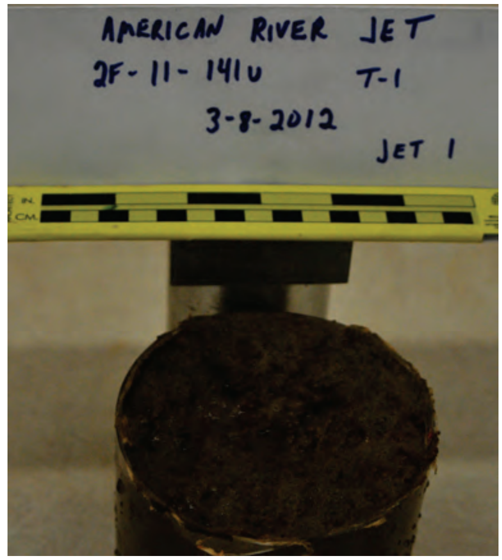


Figure A6. Sample before and after JET with erosion data of Boring 141-U Tube-1 Jet-1.

Before JET



After JET

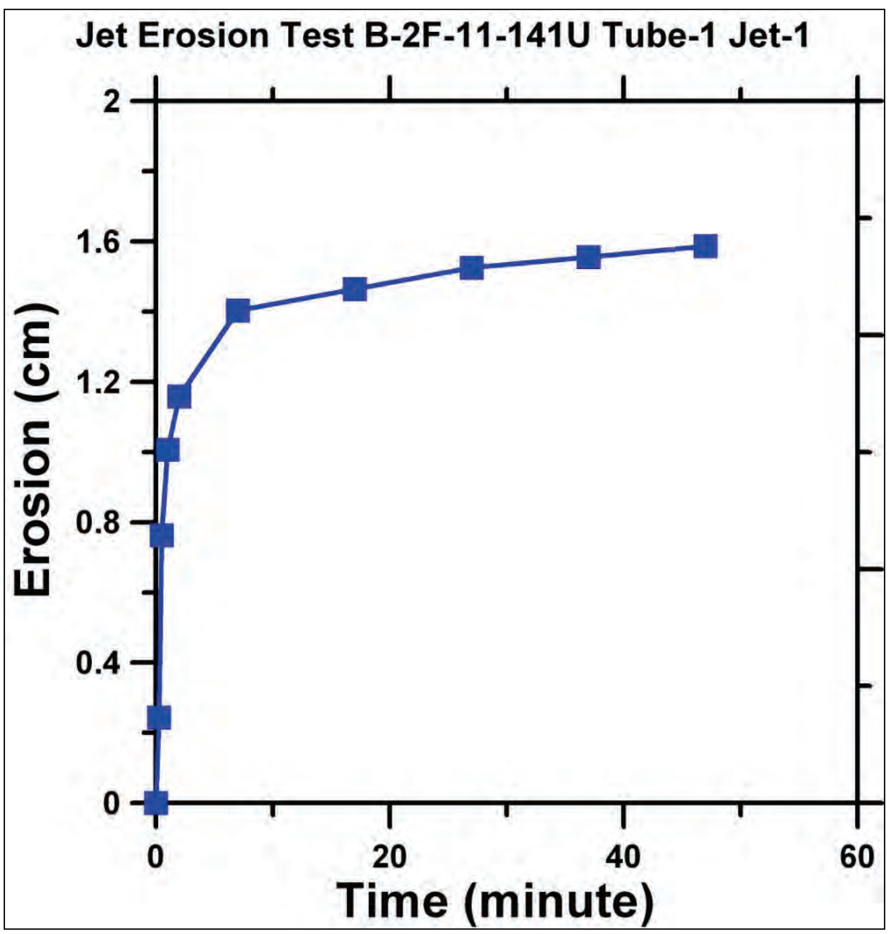


Figure A7. Sample before and after JET with erosion data of Boring 141-U Tube-1 Jet-2.

Before JET After JET

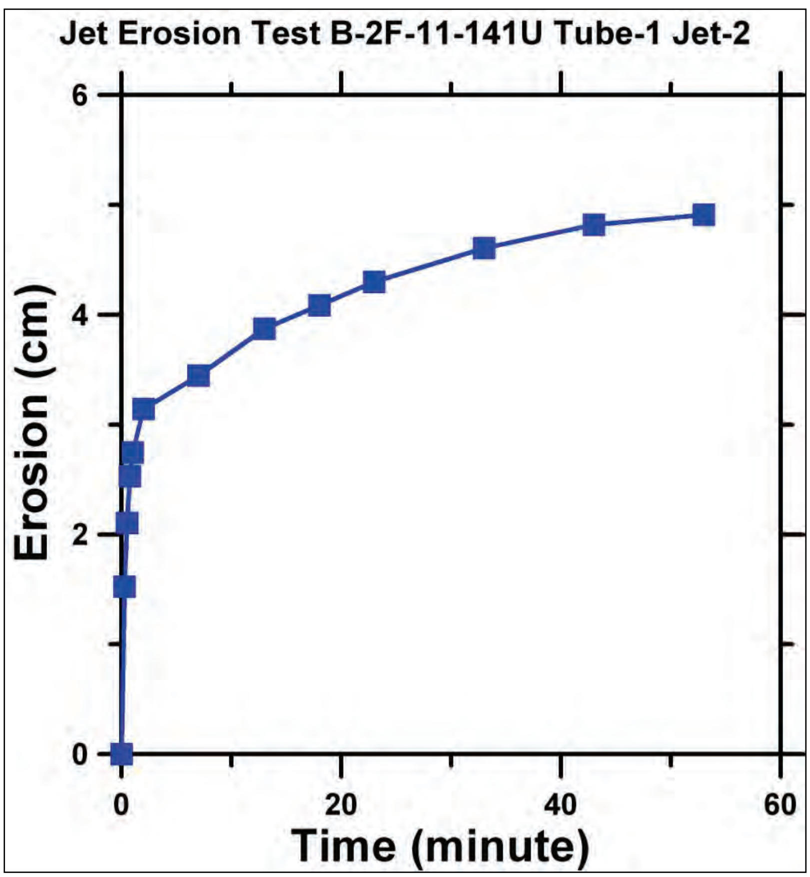


Figure A8. Sample before and after JET with erosion data of Boring 142-U Tube-3 Jet-13.

Before JET After JET

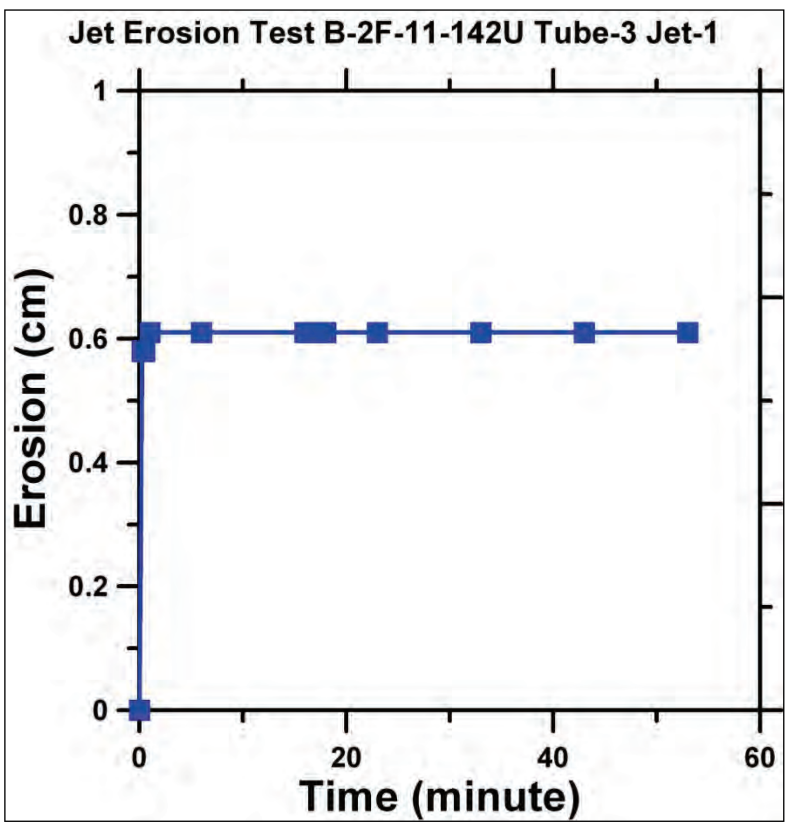
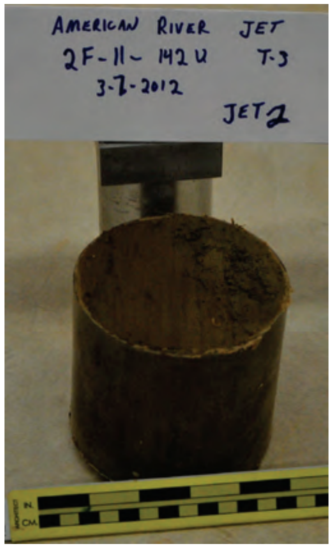


Figure A9. Sample before and after JET with erosion data of Boring 142-U Tube-1 Jet-2.



Before JET

After JET

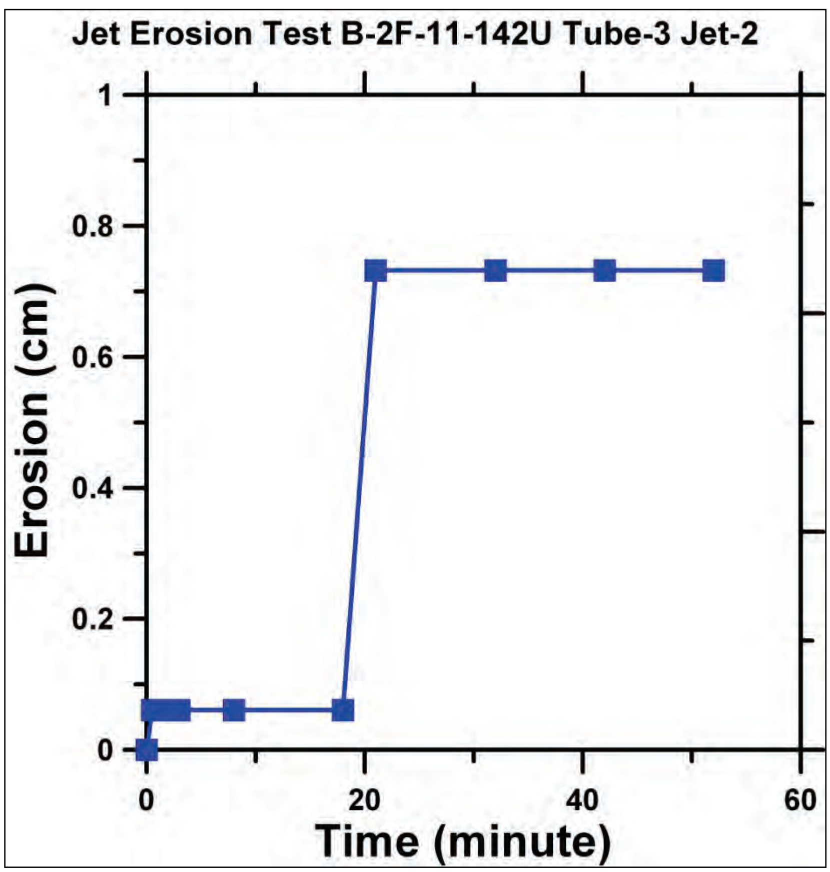


Figure A10. Sample before and after JET with erosion data of Boring 143-U Tube-3 Jet-1.

Before JET After JET

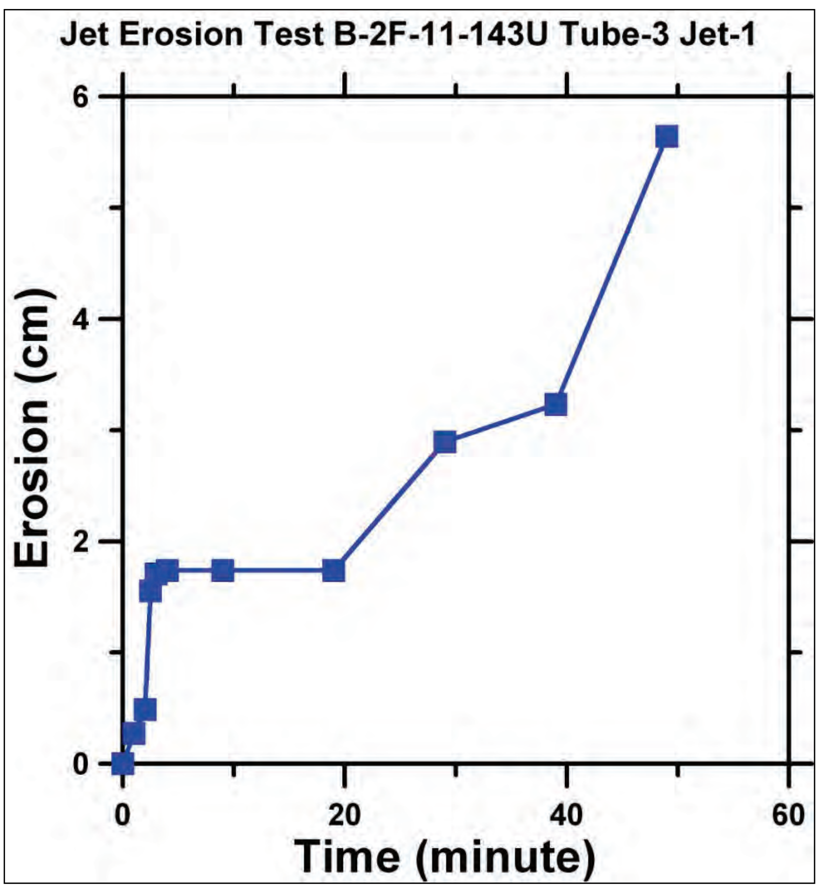
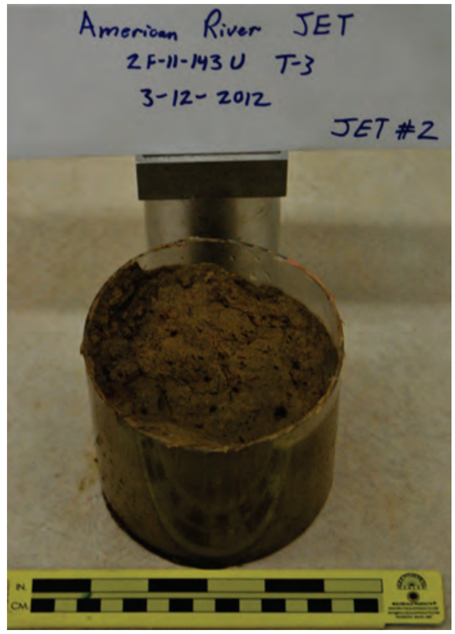


Figure A11. Sample before and after JET with erosion data of Boring 143-U Tube-3 Jet-2.

Before JET



After JET

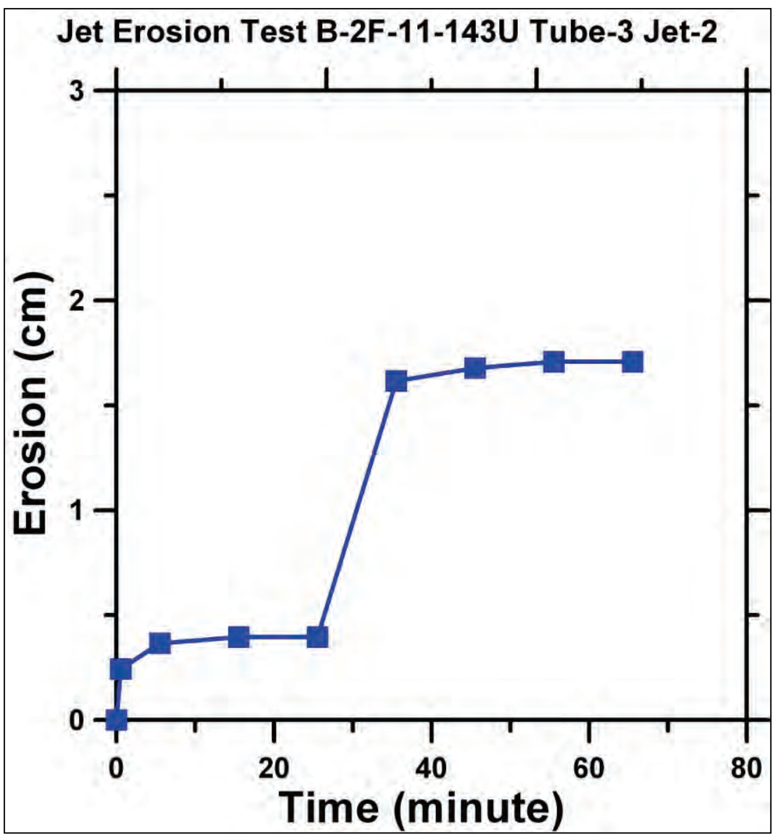


Figure A12. Sample before and after JET with erosion data of Boring 144-U Tube-1 Jet-1.

Before JET

After JET

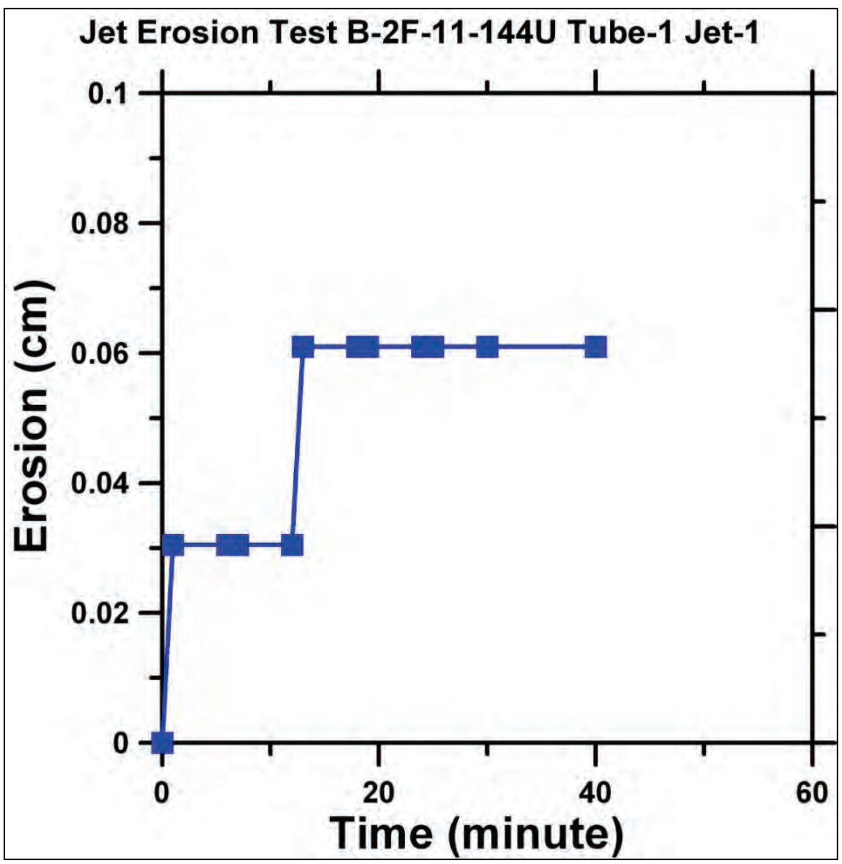
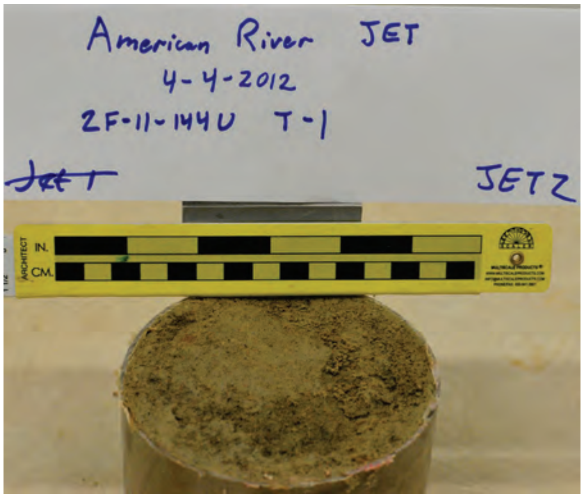
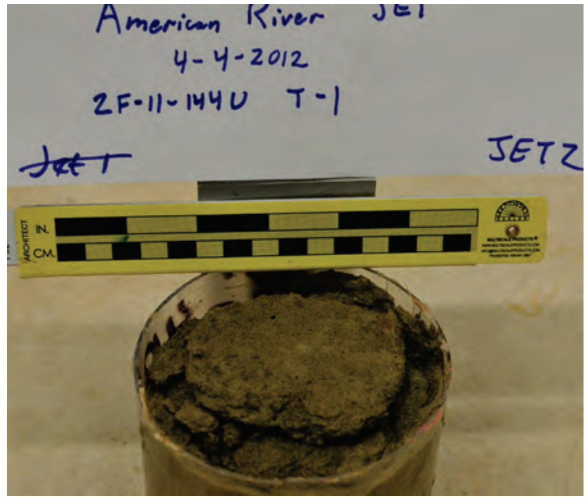


Figure A13. Sample before and after JET with erosion data of Boring 144-U Tube-1 Jet-2.



Before JET



After JET

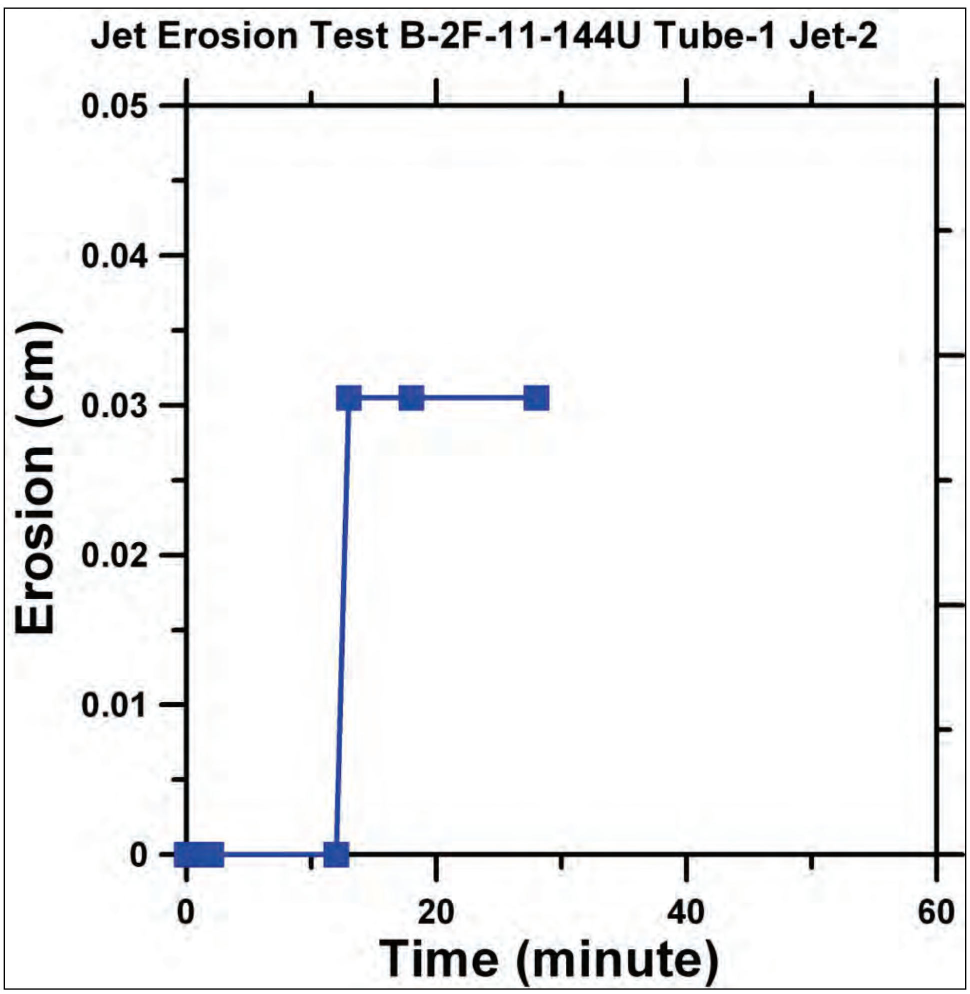


Figure A14. Sample before and after JET with erosion data of Boring 145-U Tube-2 Jet-1.

Before JET After JET

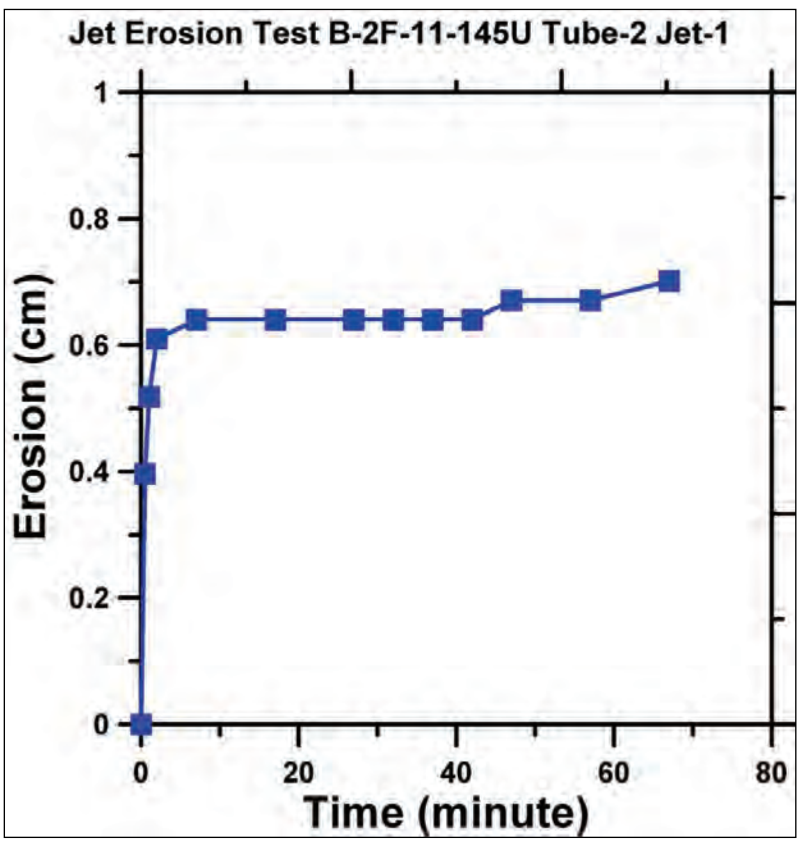


Figure A15. Sample before and after JET with erosion data of Boring 145-U Tube-2 Jet-2.

Before JET After JET

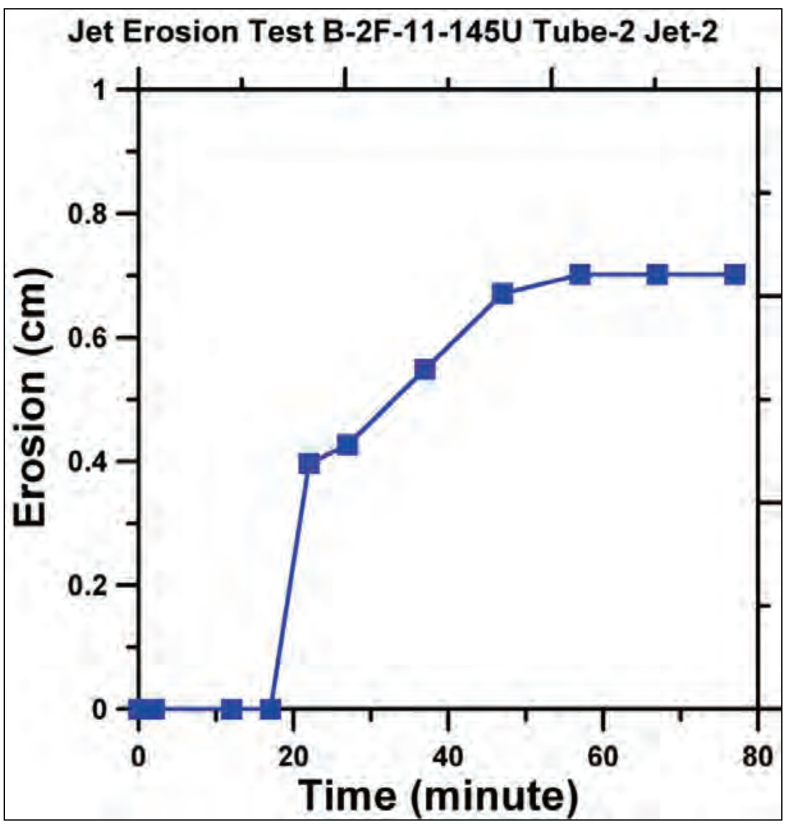
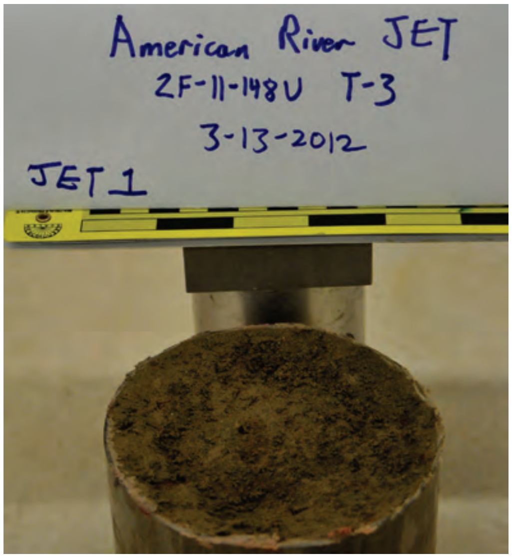


Figure A16. Sample before and after JET with erosion data of Boring 148-U Tube-3 Jet-1.



Before JET

After JET

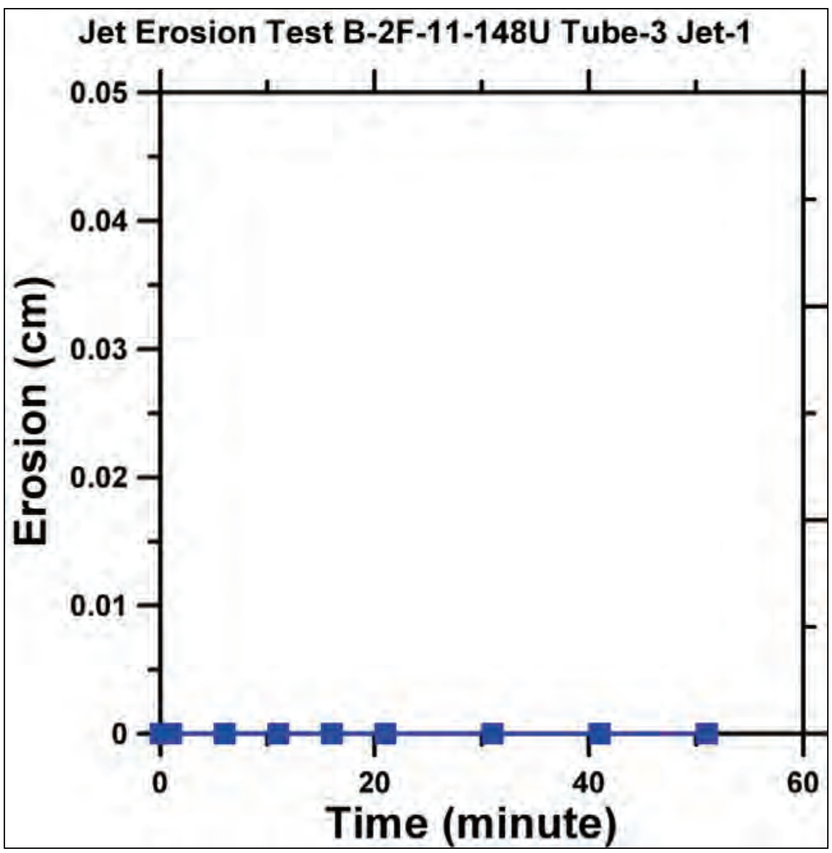


Figure A17. Sample before and after JET with erosion data of Boring 148-U Tube-3 Jet-2.

Before JET After JET

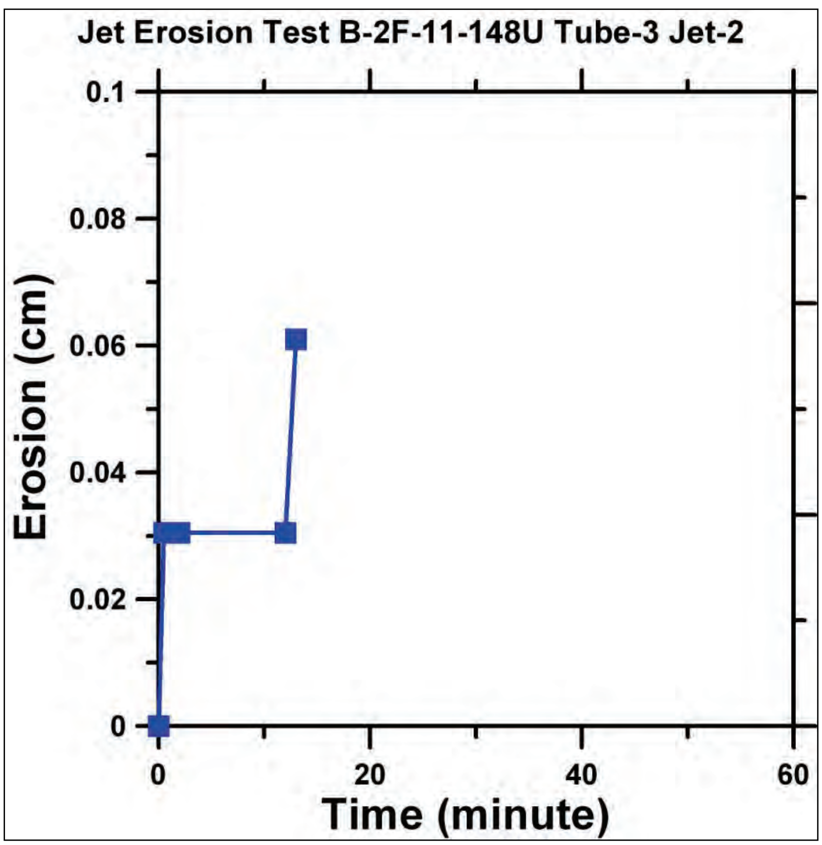


Figure A18. Sample before and after JET with erosion data of Boring 151-U Tube-2 Jet-1.

Before JET

After JET

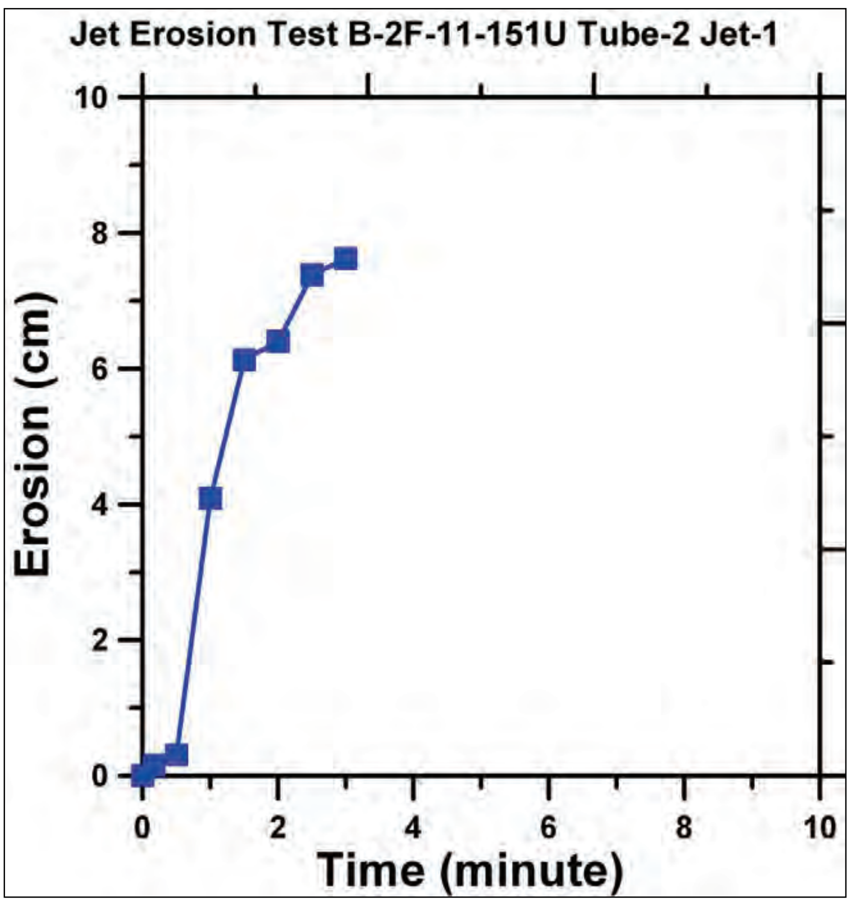
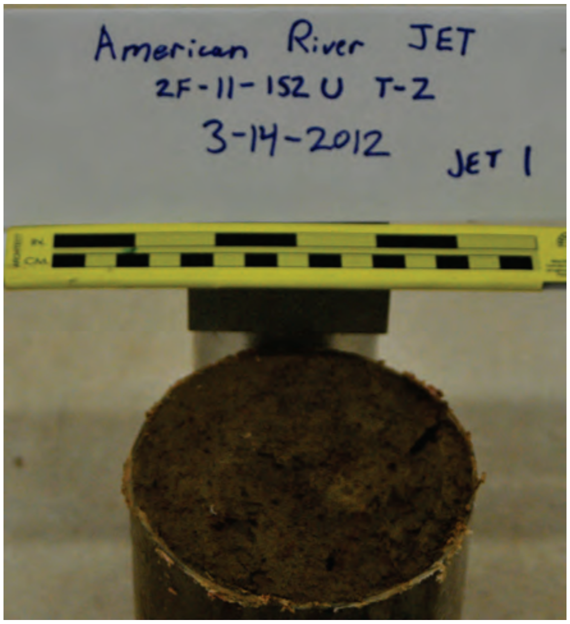
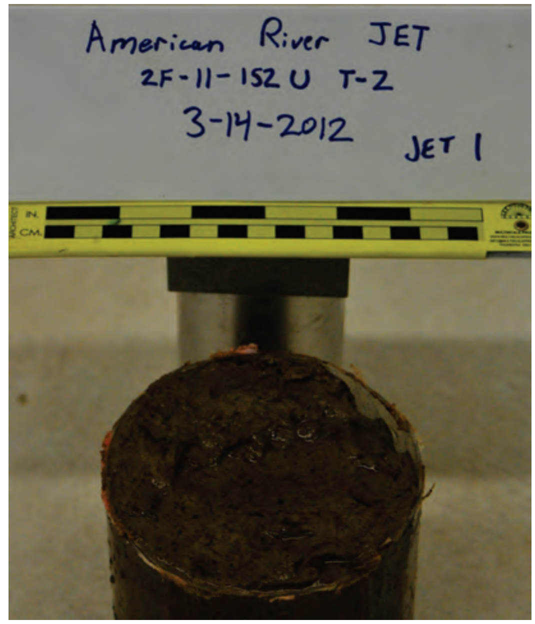


Figure A19. Sample before and after JET with erosion data of Boring 152-U Tube-2 Jet-1.



Before JET



After JET

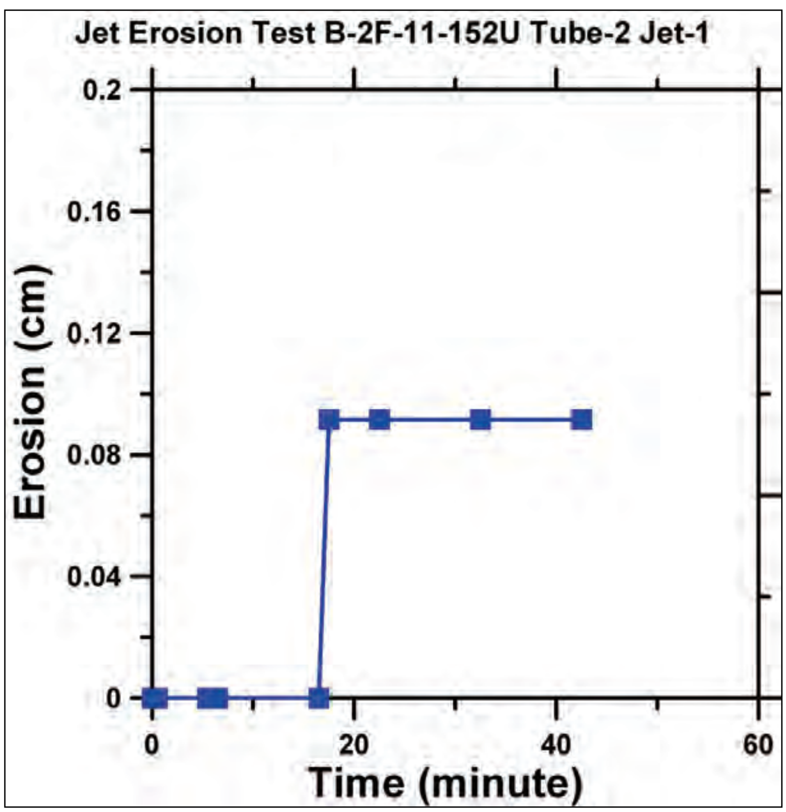
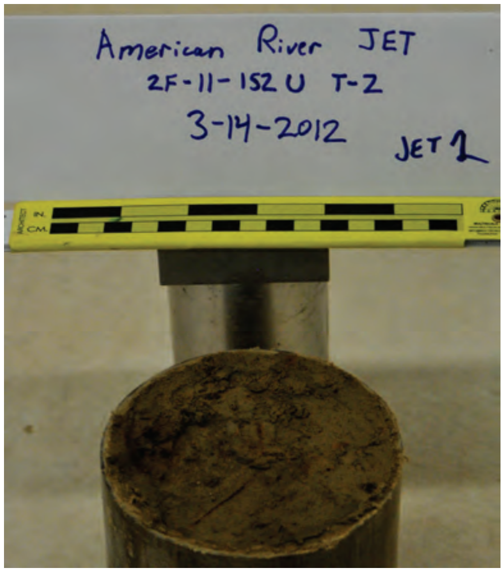
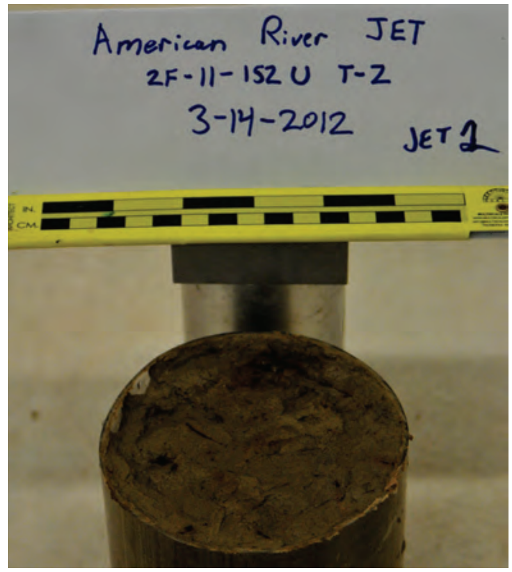


Figure A20. Sample before and after JET with erosion data of Boring 152-U Tube-2 Jet-2.



Before JET



After JET

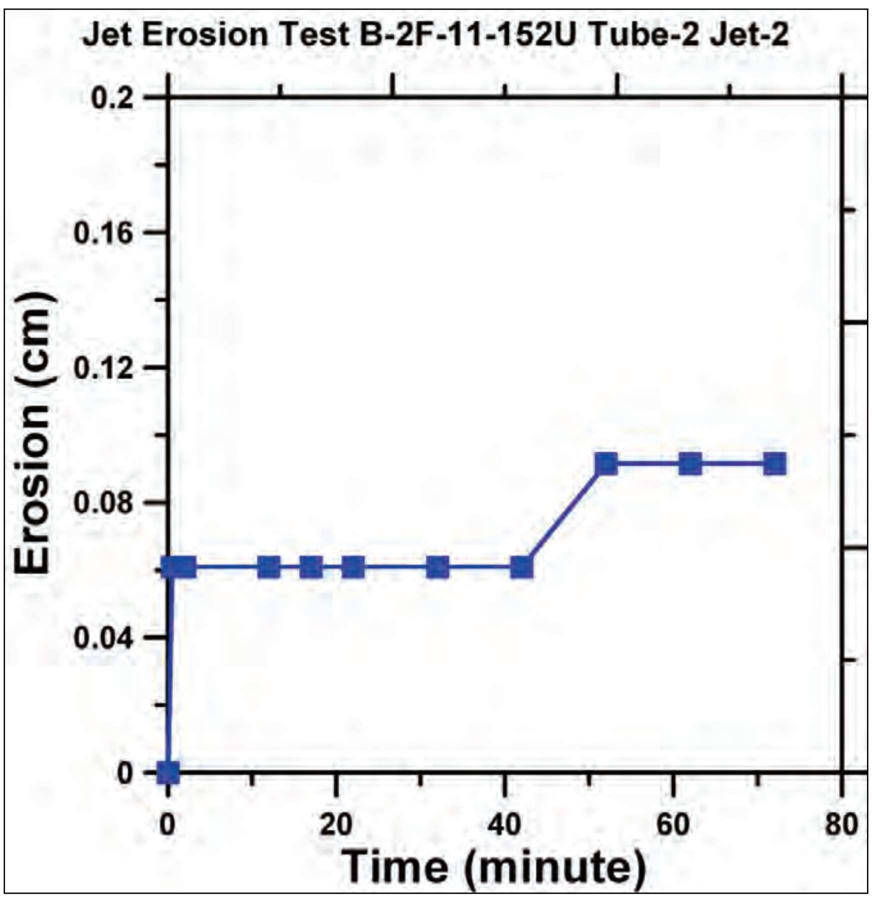
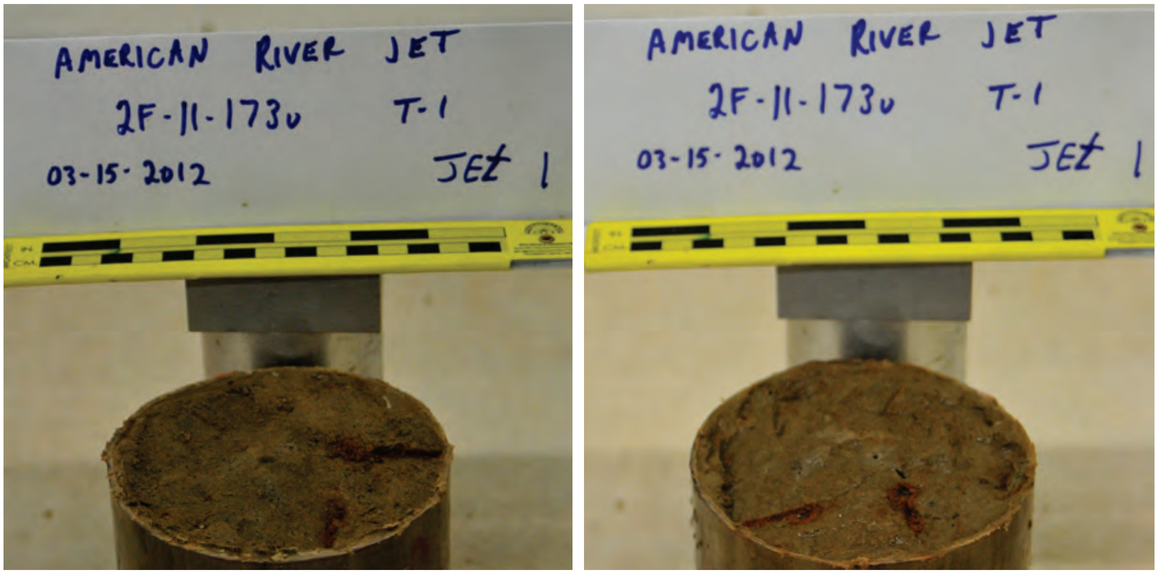


Figure A21. Sample before and after JET with erosion data of Boring 173-U Tube-1 Jet-1.



Before JET After JET

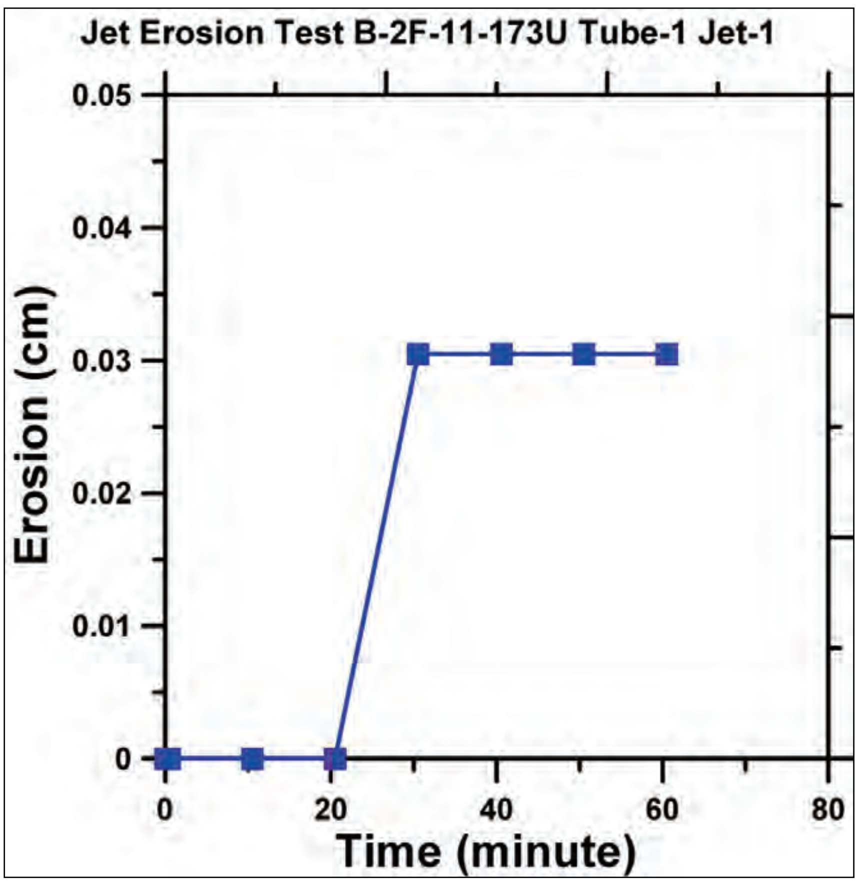
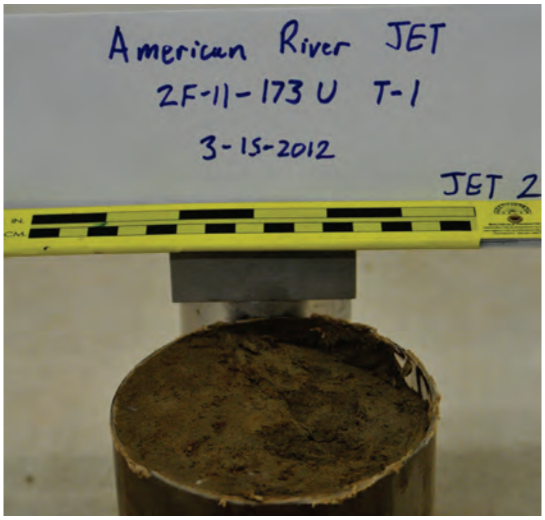
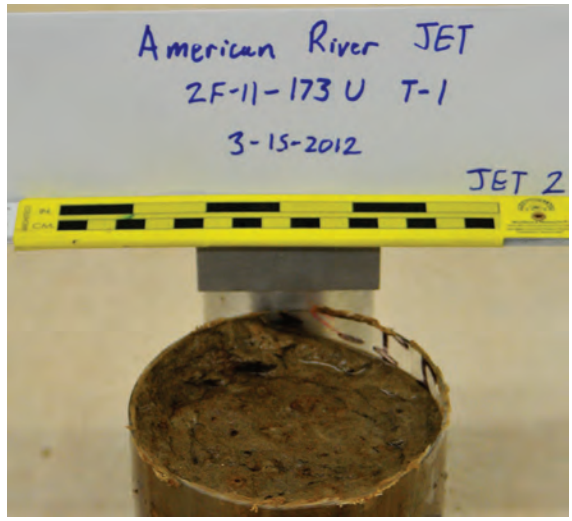


Figure A22. Sample before and after JET with erosion data of Boring 173-U Tube-1 Jet-2.



Before JET



After JET

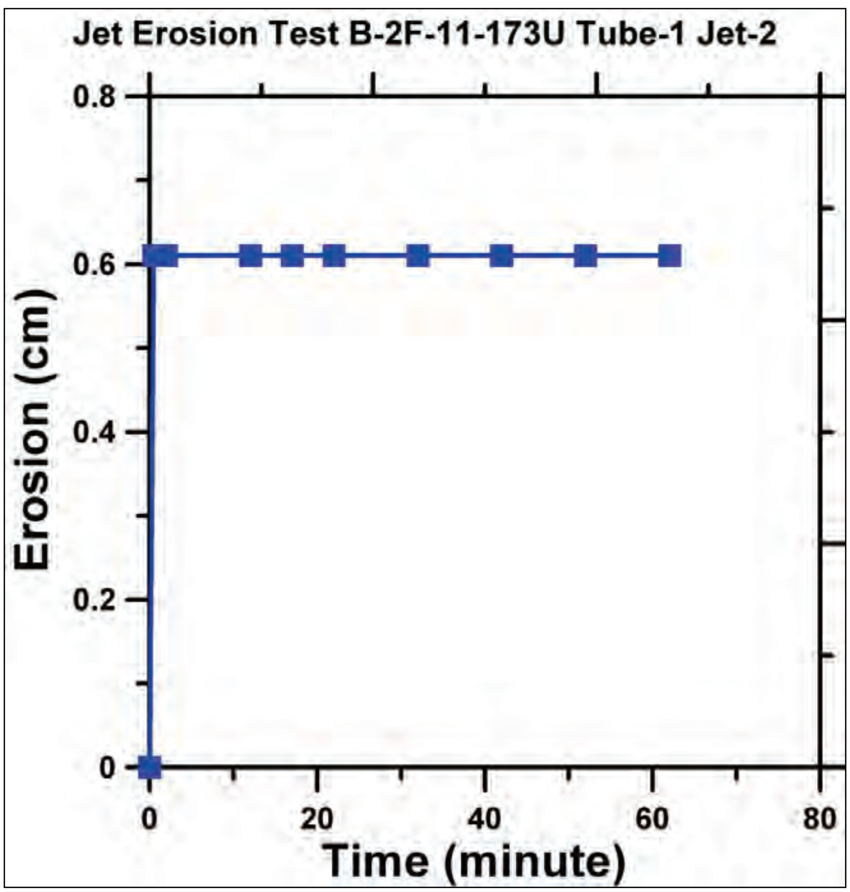
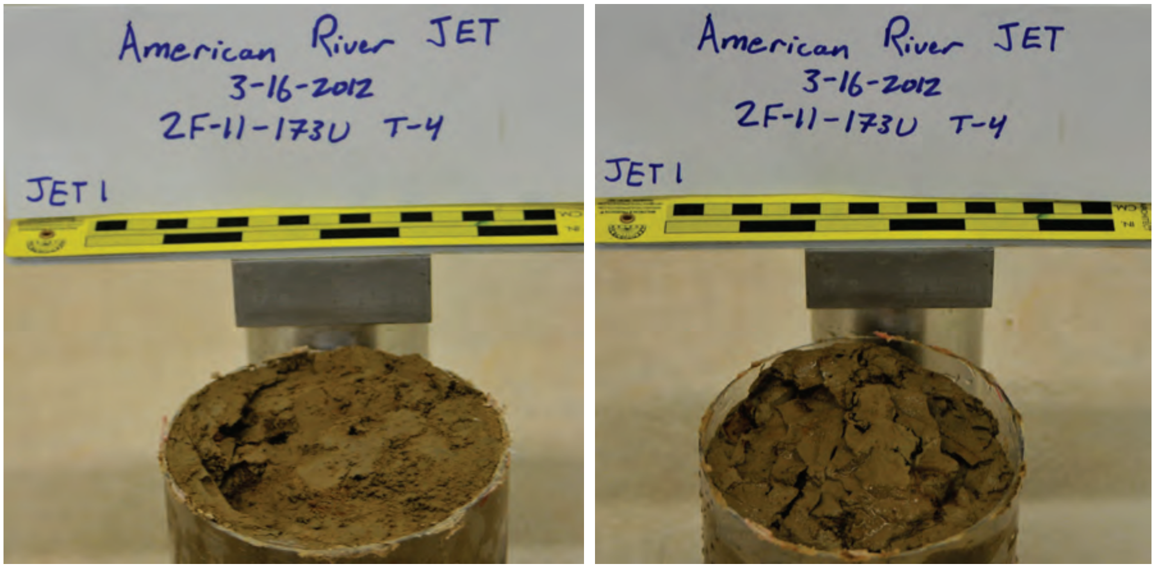


Figure A23. Sample before and after JET with erosion data of Boring 173-U Tube-4 Jet-1.



Before JET After JET

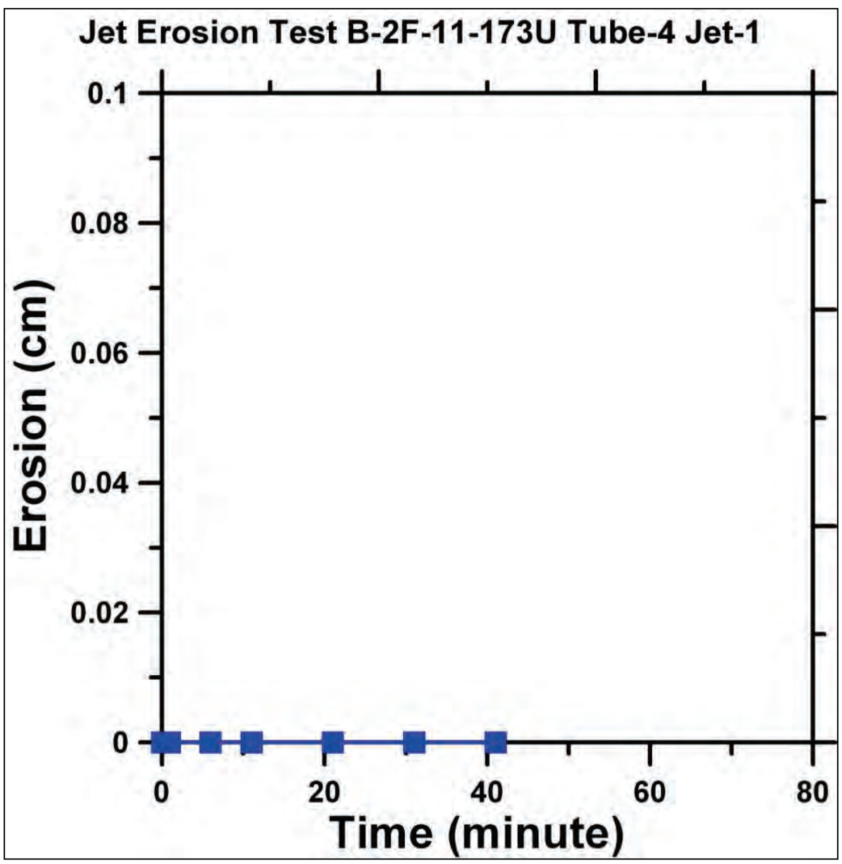
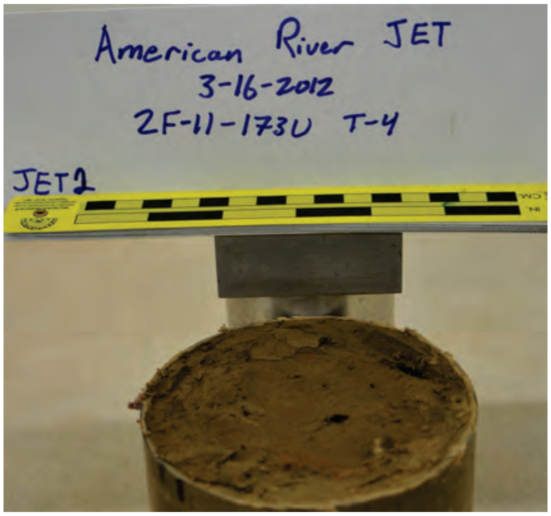


Figure A24. Sample before and after JET with erosion data of Boring 173-U Tube-4 Jet-2.



Before JET

After JET

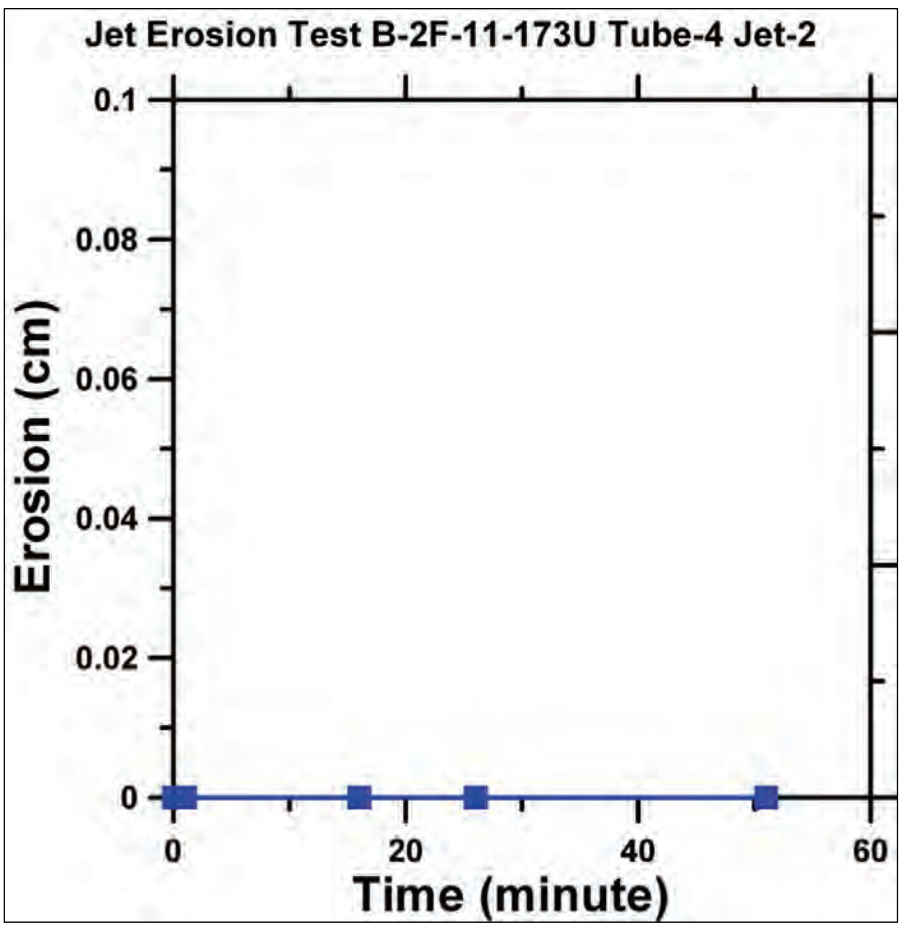
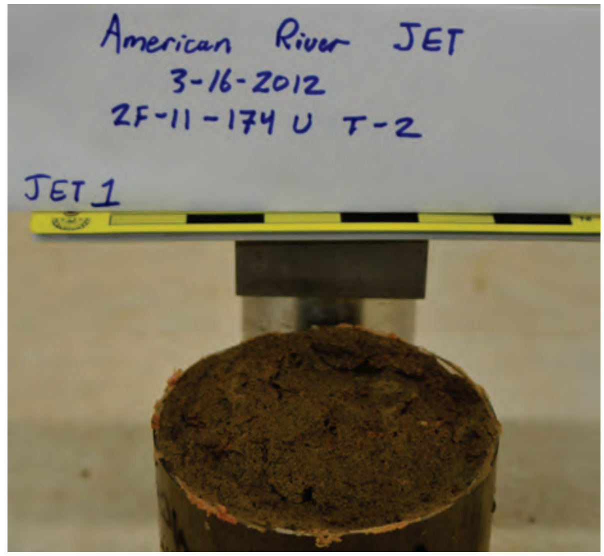


Figure A25. Sample before and after JET with erosion data of Boring 174-U Tube-2 Jet-1.



Before JET After JET

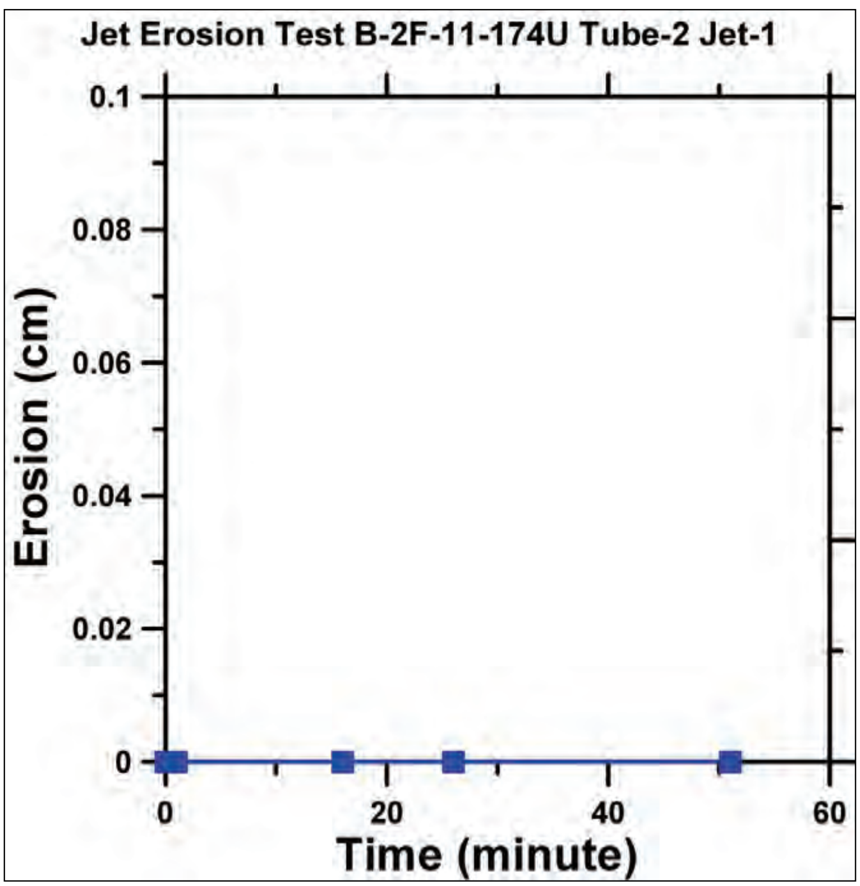
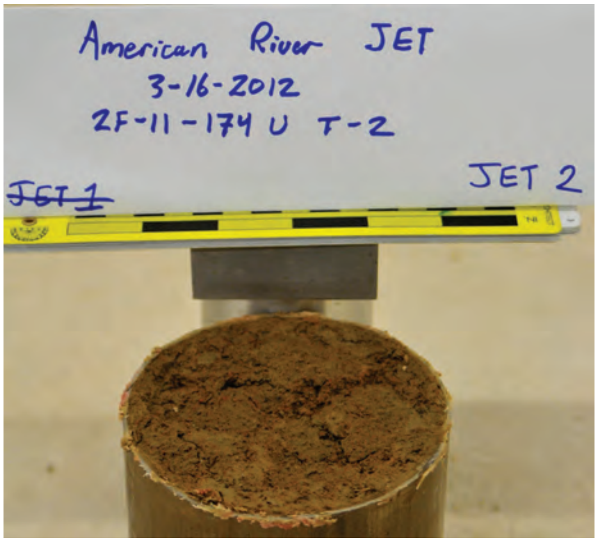


Figure A26. Sample before and after JET with erosion data of Boring 174-U Tube-2 Jet-2.



Before JET After JET

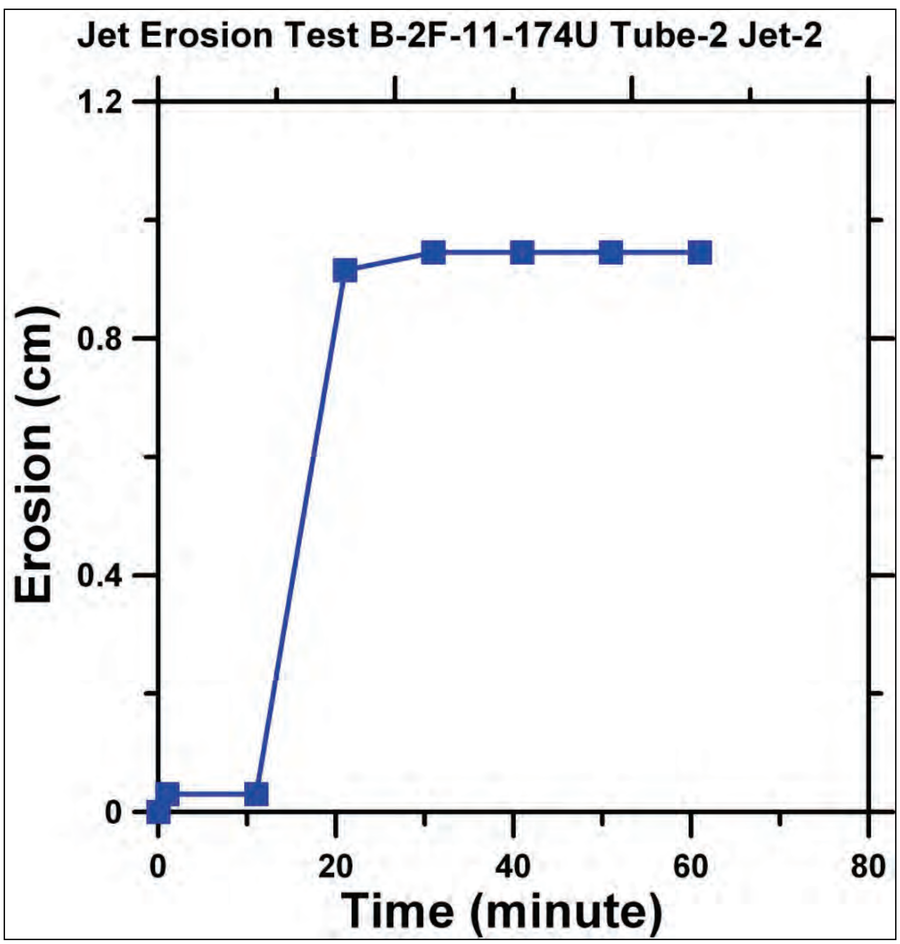


Figure A27. Sample before and after JET with erosion data of Boring 174-U Tube-4 Jet-1.

Before JET

After JET

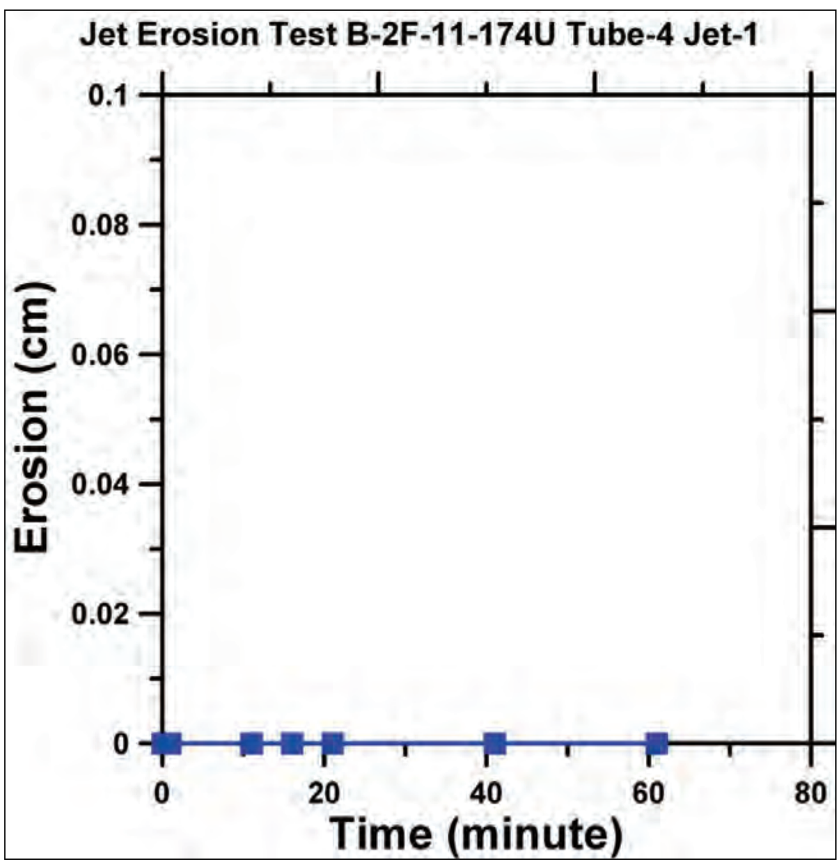
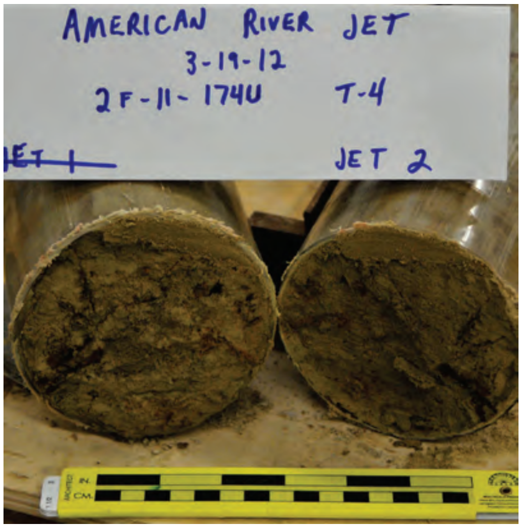


Figure A28. Sample before and after JET with erosion data of Boring 174-U Tube-4 Jet-2.



Before JET

After JET

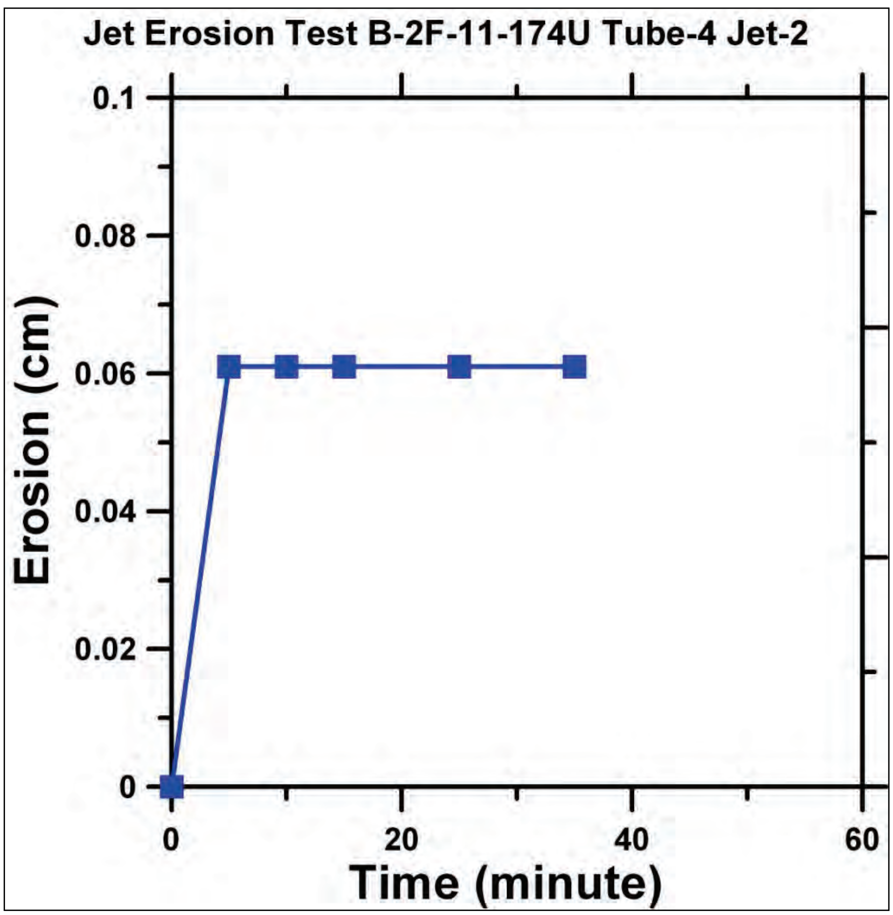
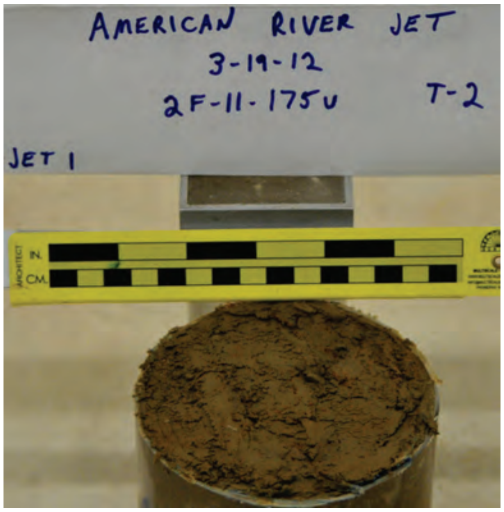
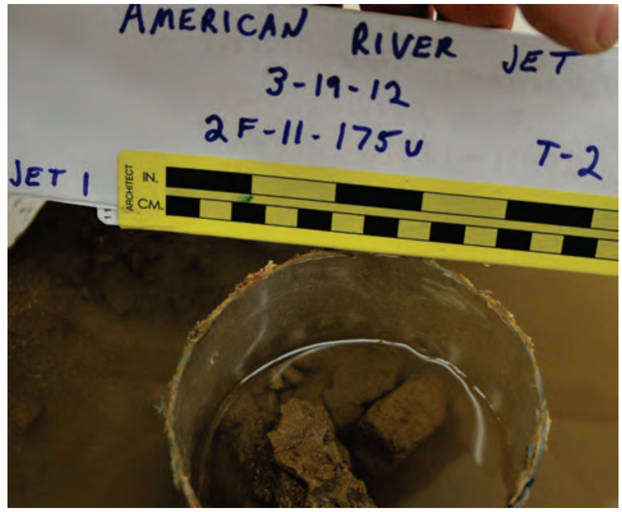


Figure A29. Sample before and after JET with erosion data of Boring 175-U Tube-2 Jet-1.



Before JET



After JET

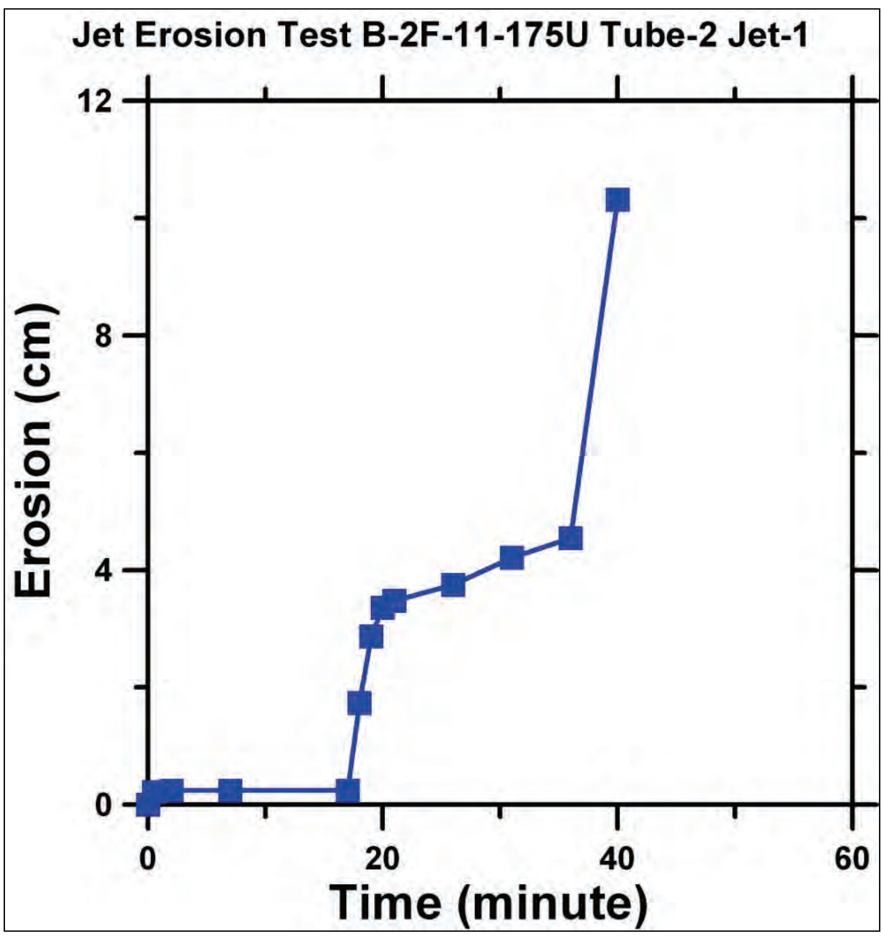
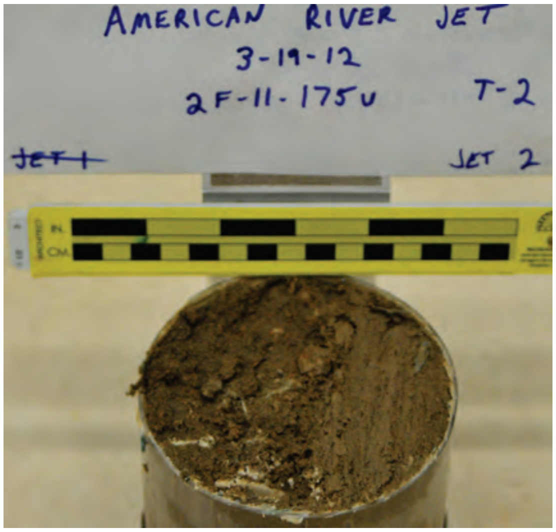
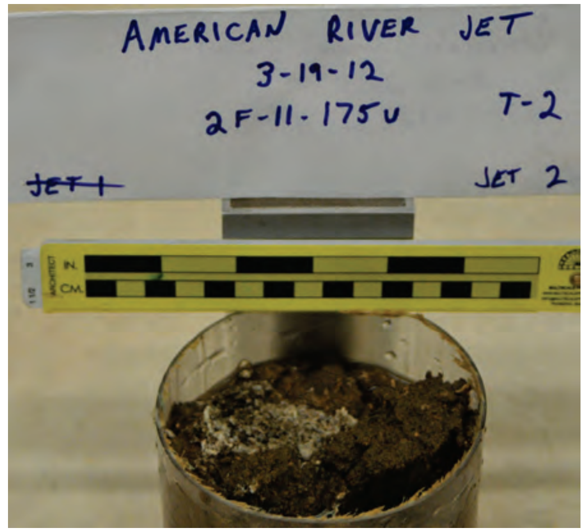


Figure A30. Sample before and after JET with erosion data of Boring 175-U Tube-2 Jet-2.



Before JET



After JET

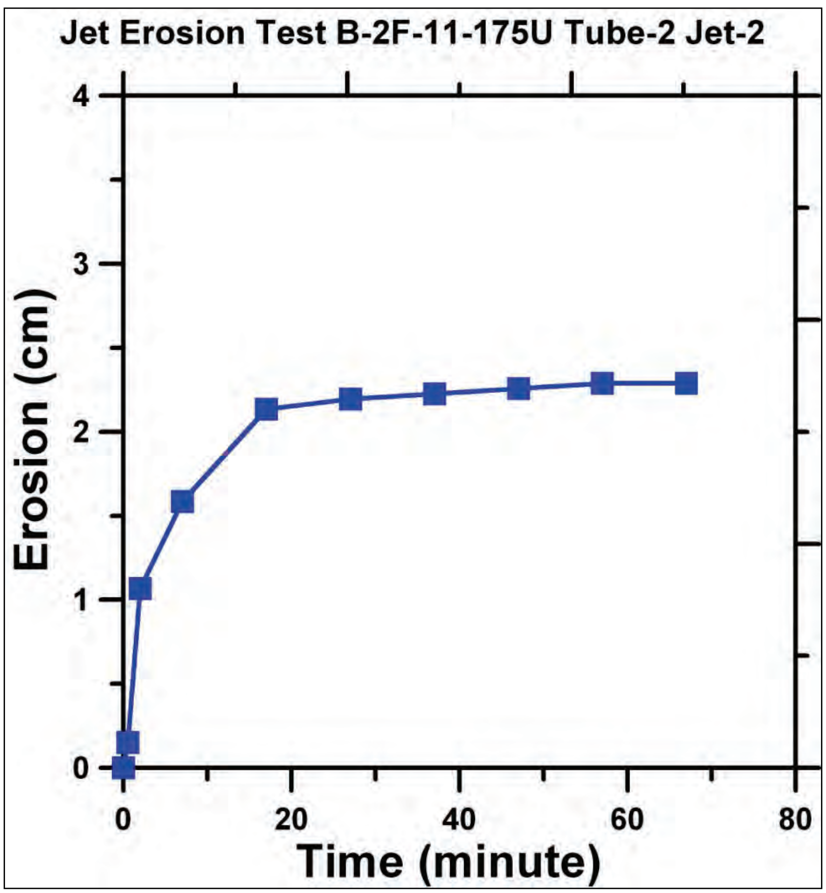
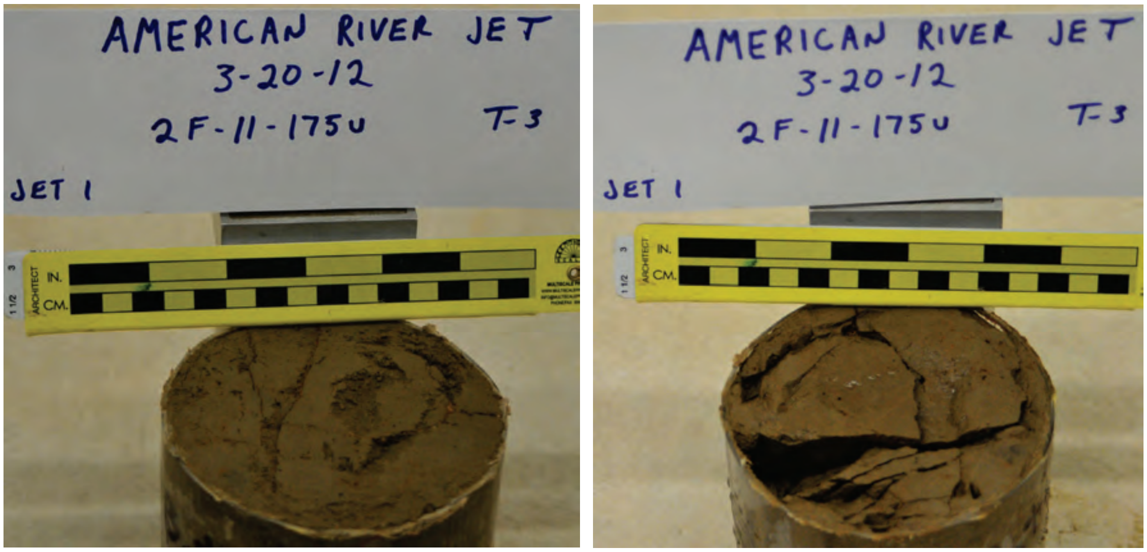


Figure A31. Sample before and after JET with erosion data of Boring 175-U Tube-3 Jet-1.



Before JET After JET

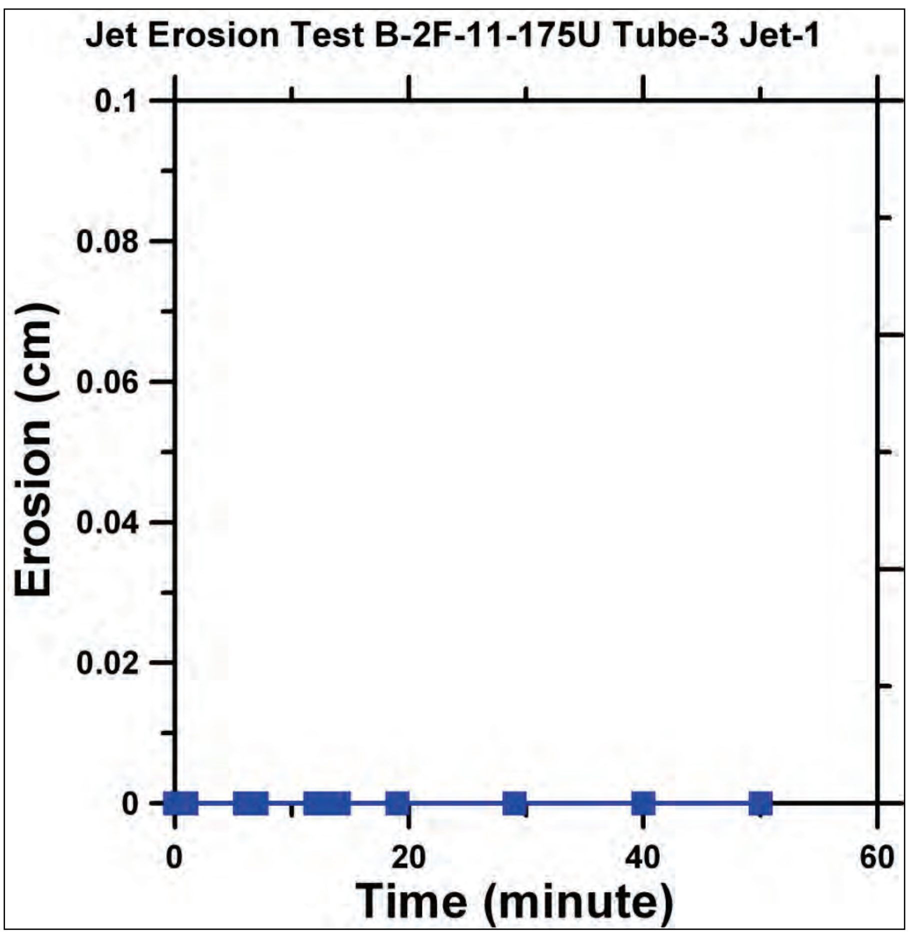


Figure A32. Sample before and after JET with erosion data of Boring 175-U Tube-3 Jet-2.

Before JET

After JET

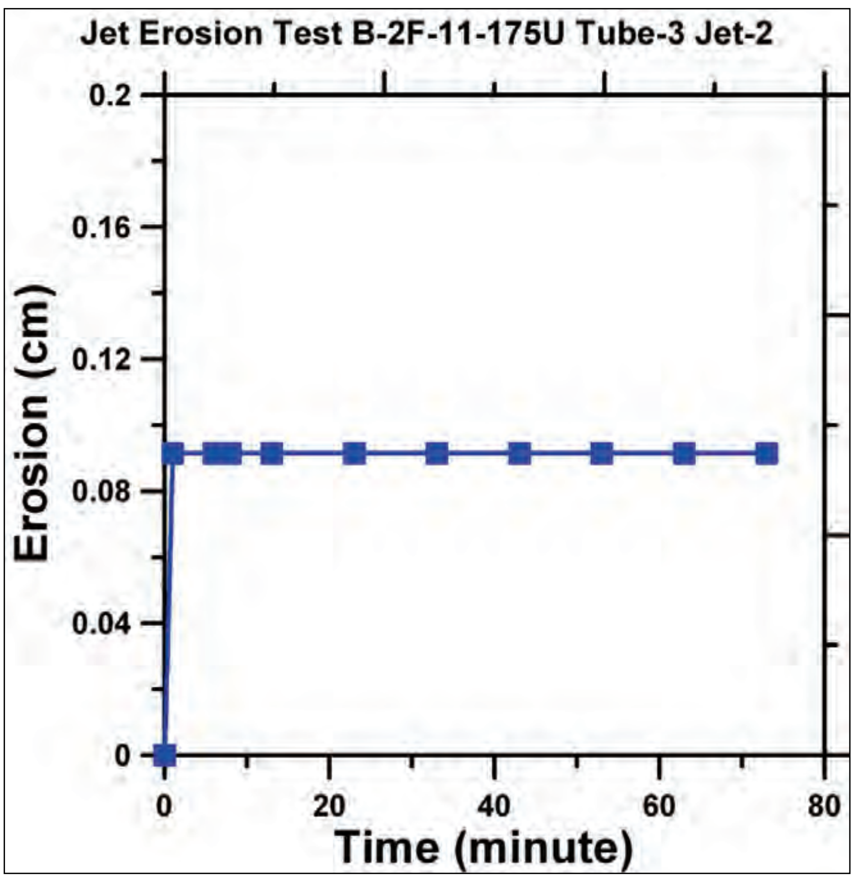
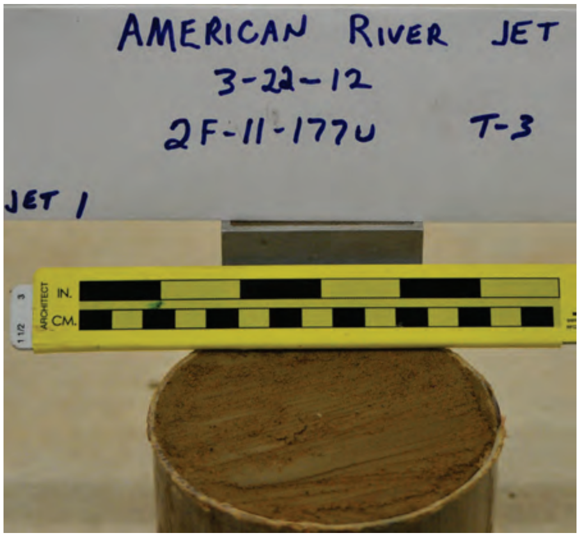


Figure A33. Sample before and after JET with erosion data of Boring 177-U Tube-3 Jet-1.



Before JET

After JET

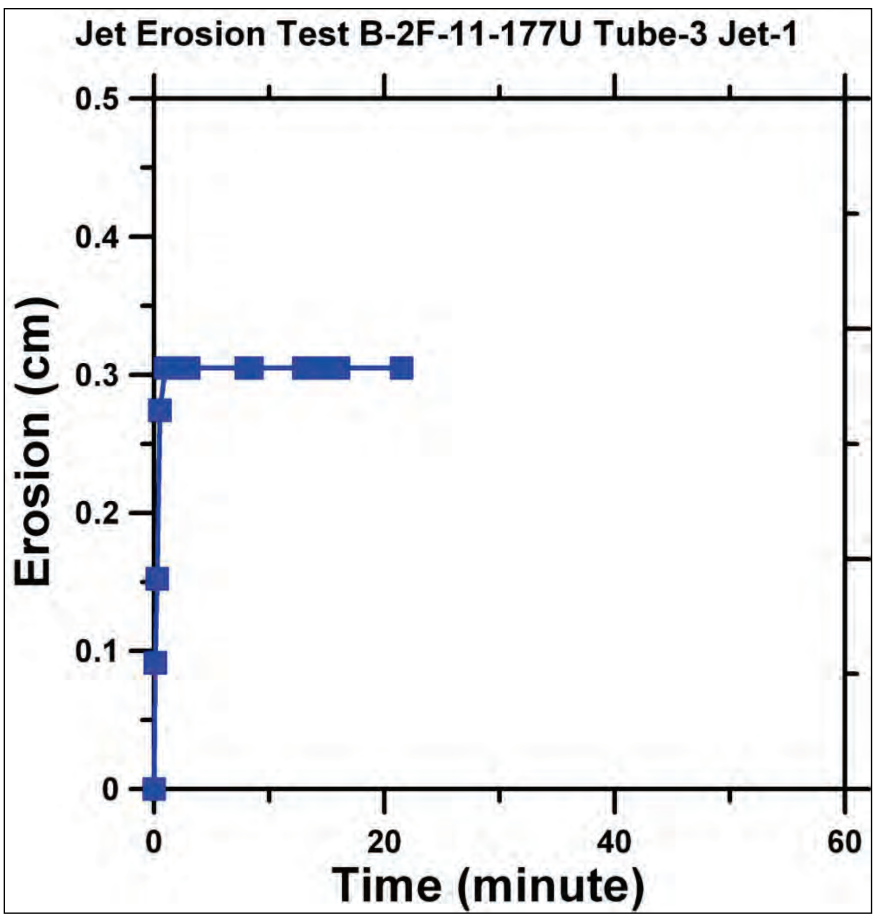
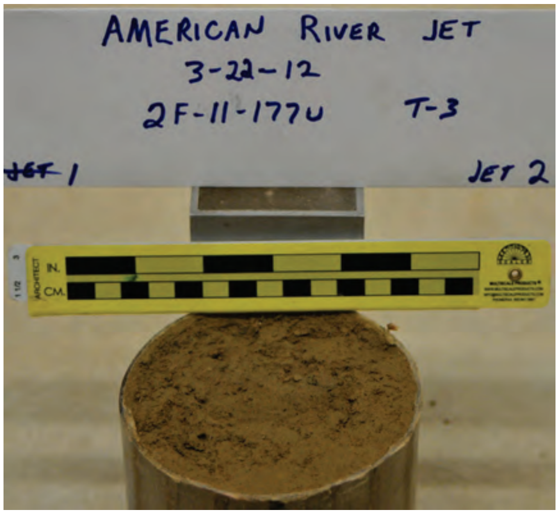
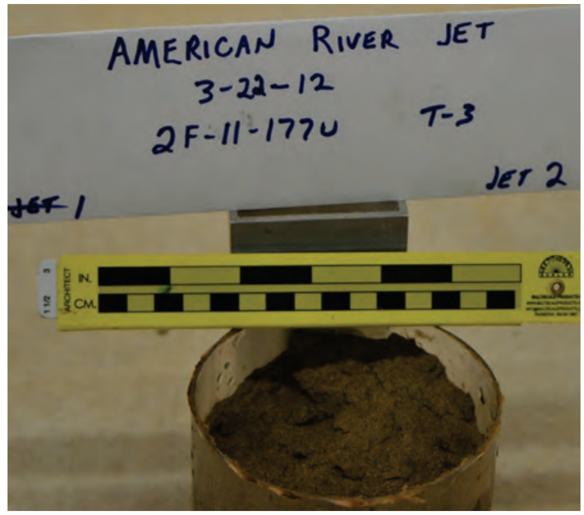


Figure A34. Sample before and after JET with erosion data of Boring 177-U Tube-3 Jet-2.



Before JET



After JET

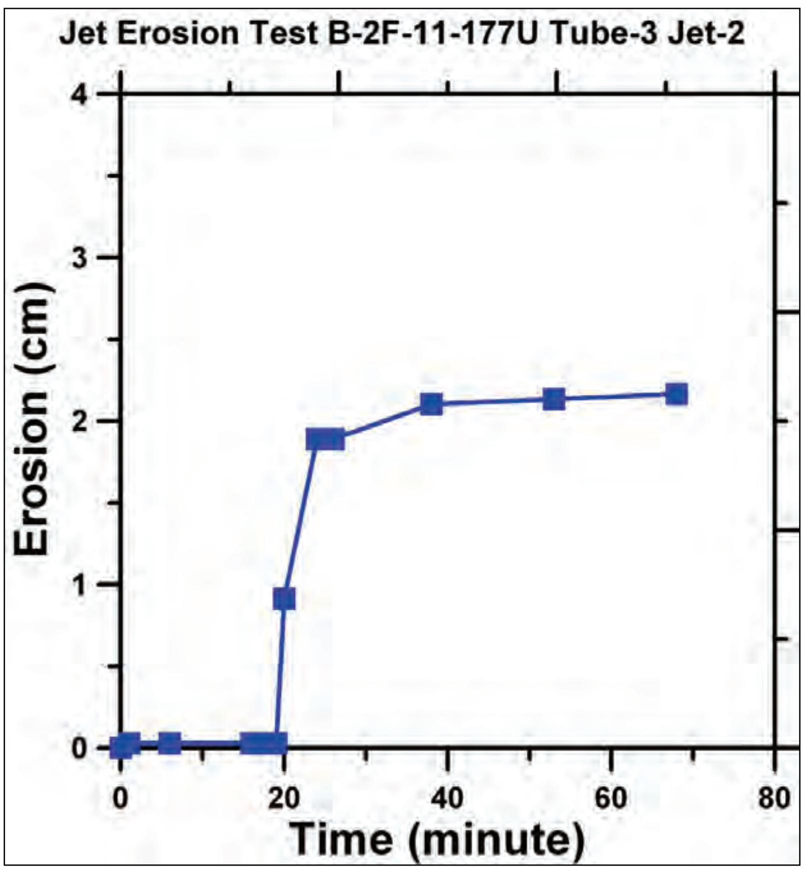
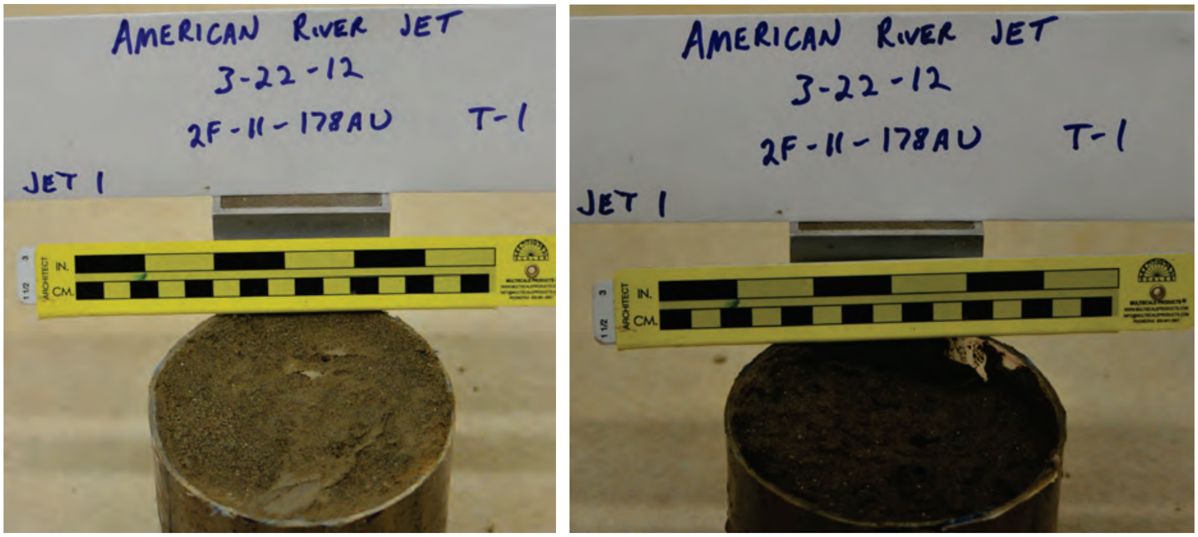


Figure A35. Sample before and after JET with erosion data of Boring 178A-U Tube-1 Jet-1.



Before JET After JET

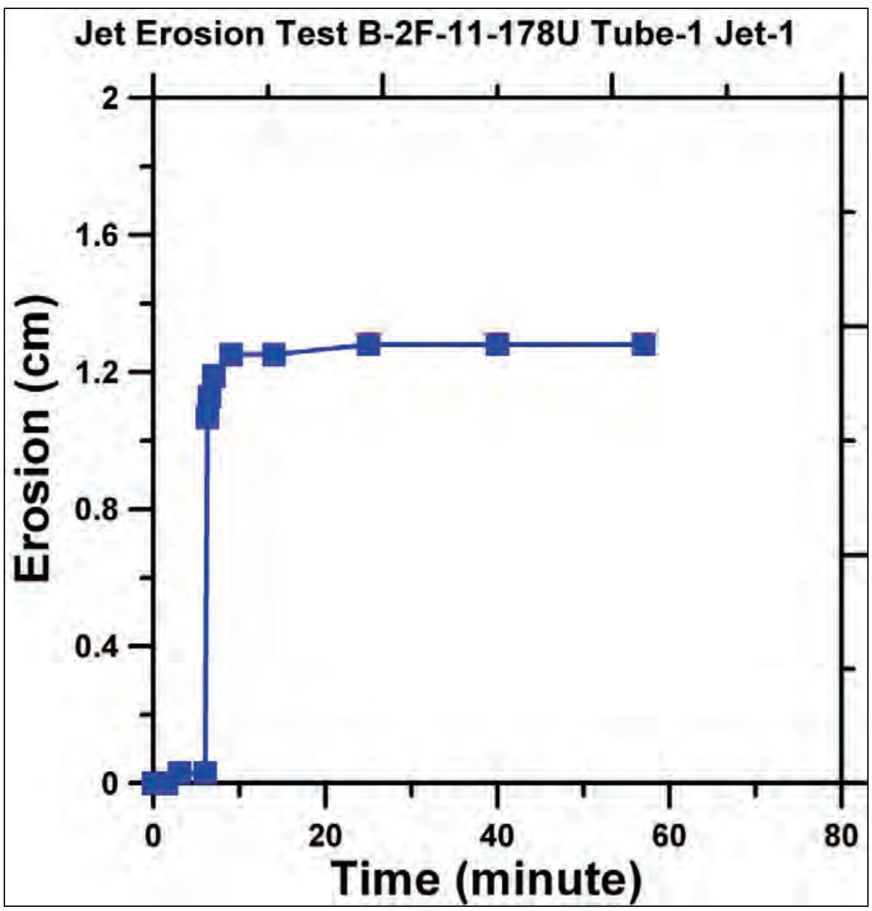
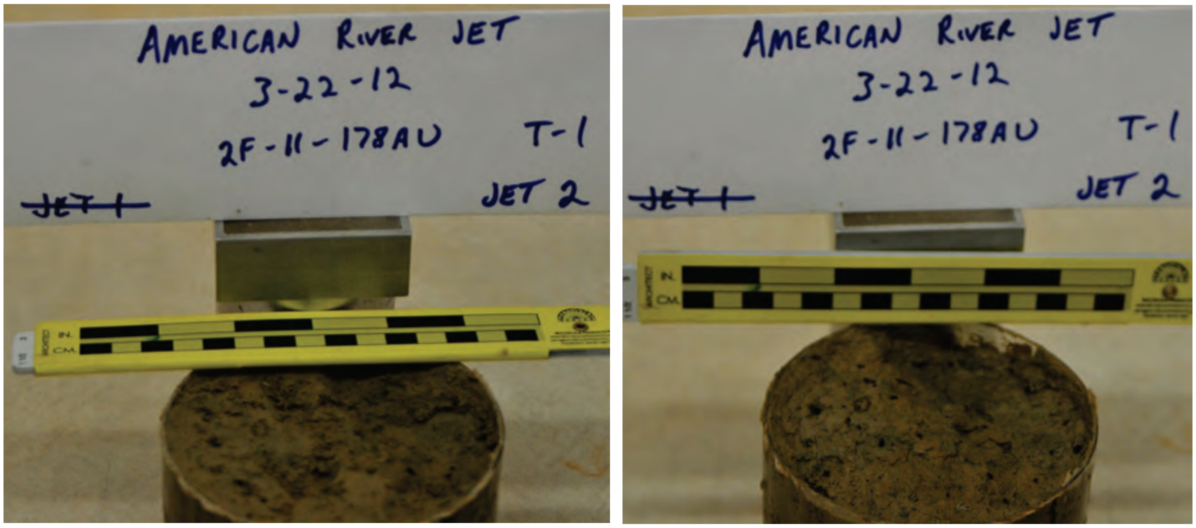


Figure A36. Sample before and after JET with erosion data of Boring 178A-U Tube-1 Jet-2.



Before JET After JET

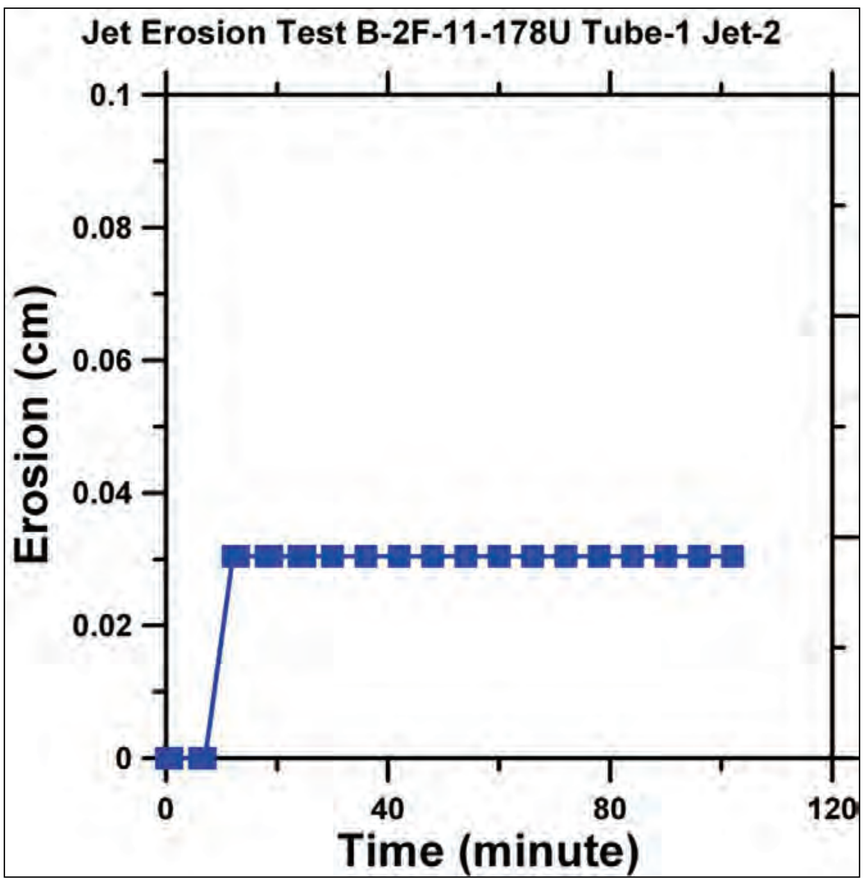
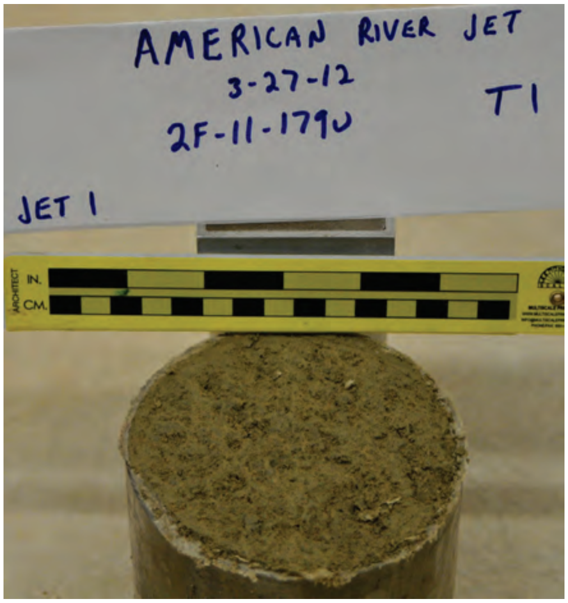


Figure A37. Sample before and after JET with erosion data of Boring 179-U Tube-1 Jet-1.



Before JET

After JET

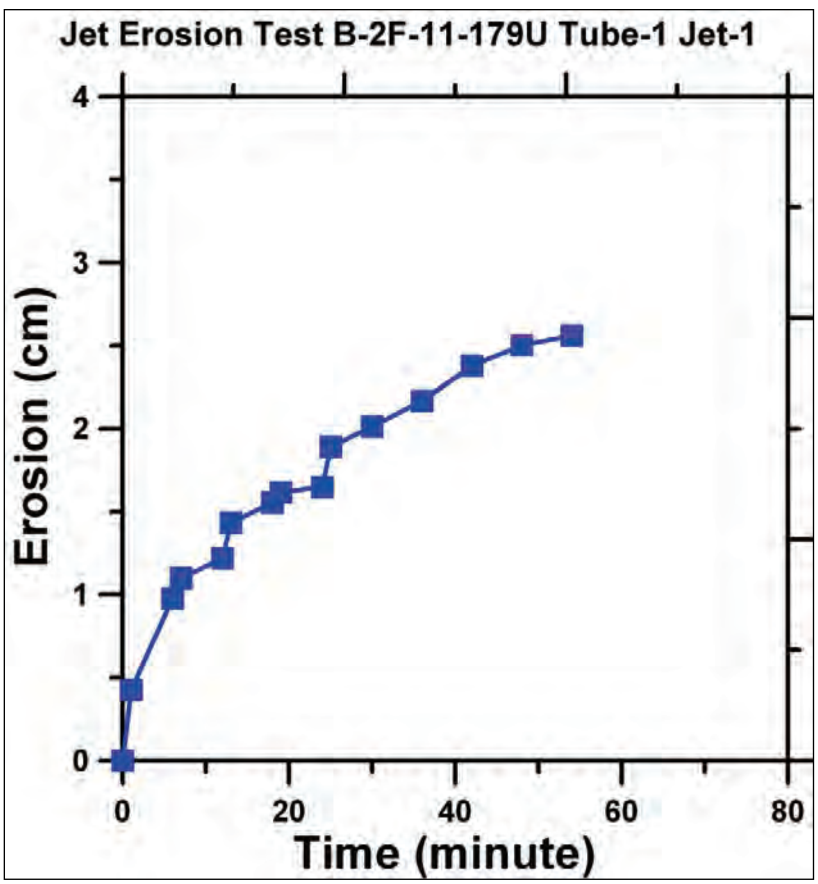
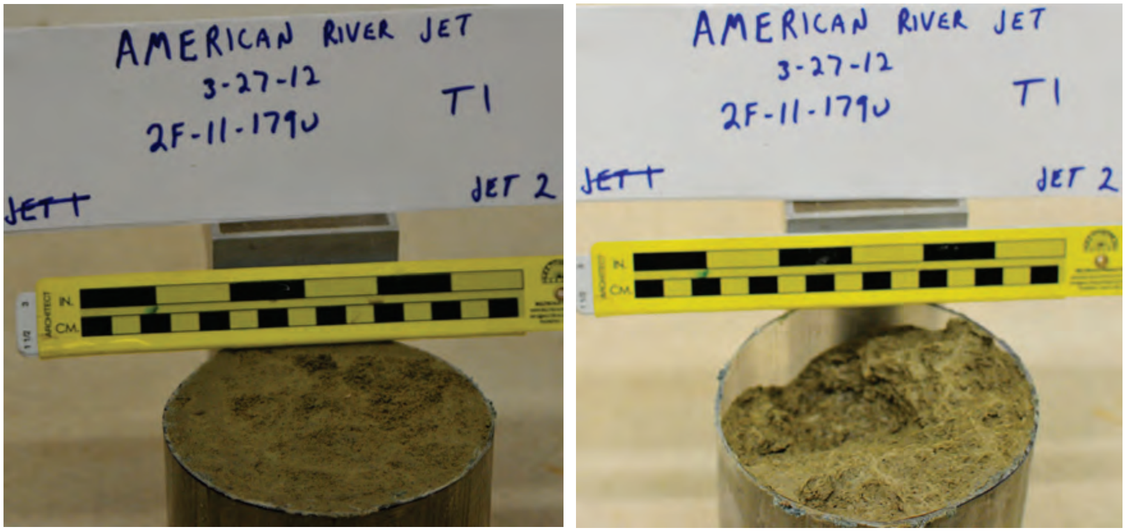


Figure A38. Sample before and after JET with erosion data of Boring 179-U Tube-1 Jet-2.



Before JET After JET

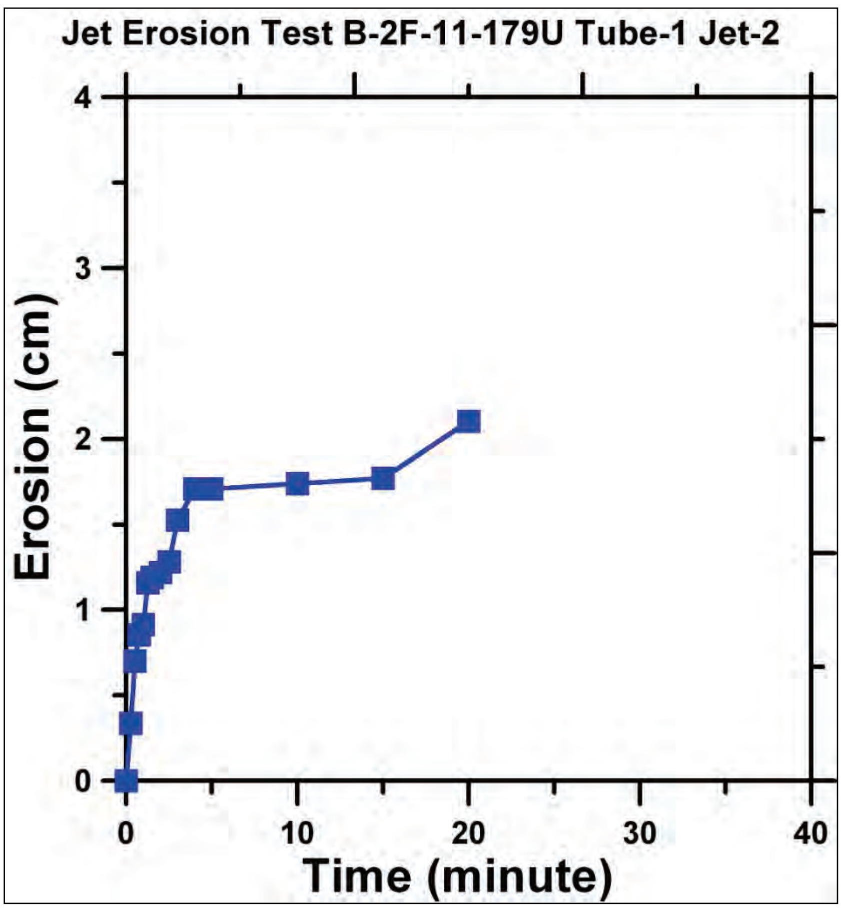
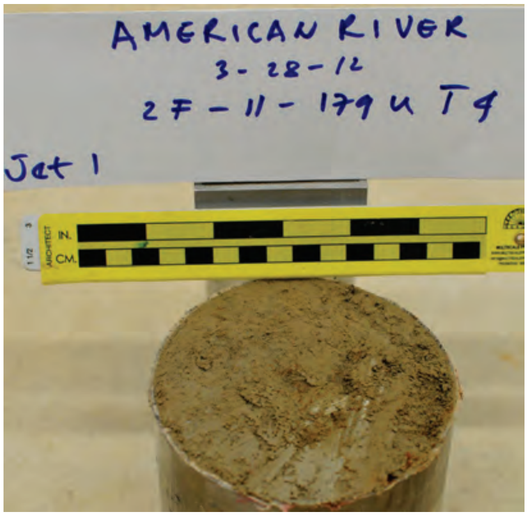
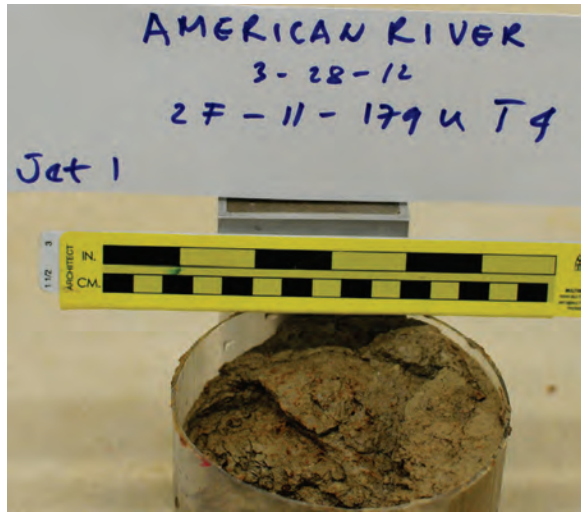


Figure A39. Sample before and after JET with erosion data of Boring 179-U Tube-4 Jet-1.



Before JET



After JET

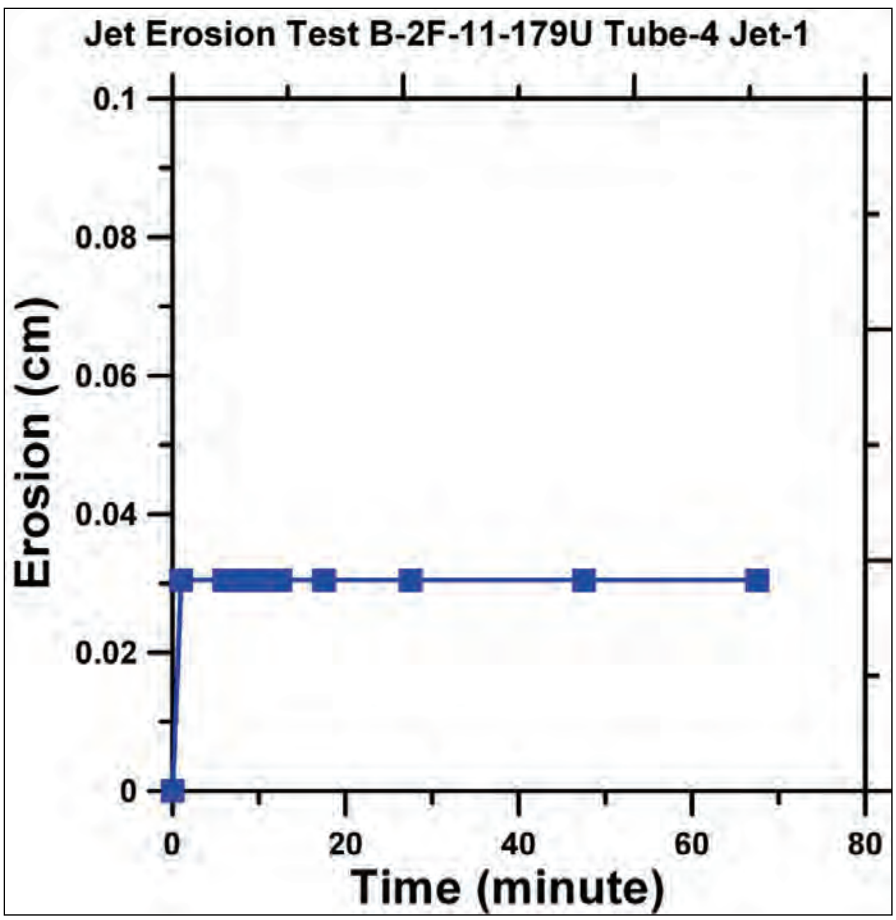
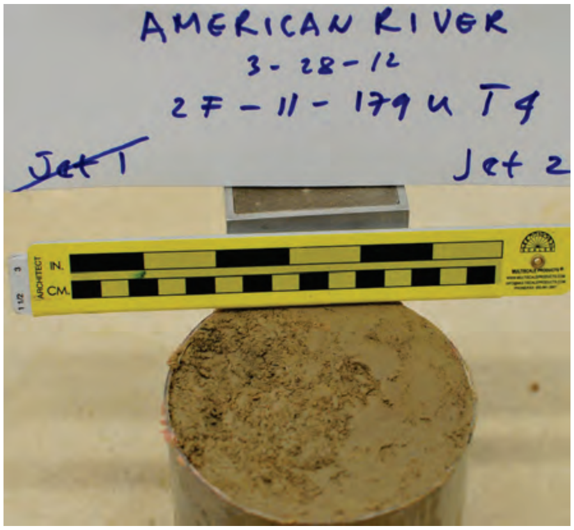
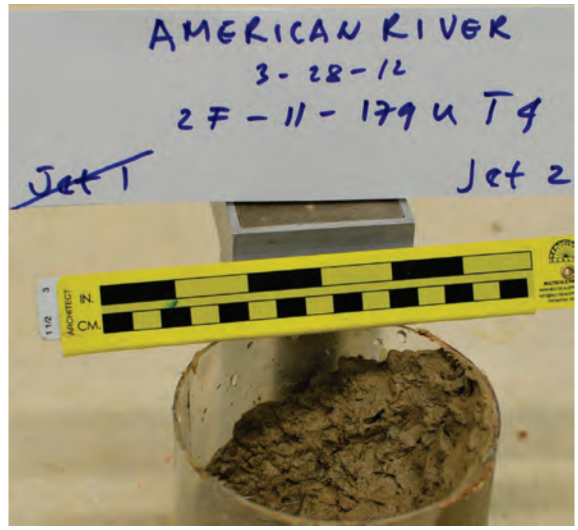


Figure A40. Sample before and after JET with erosion data of Boring 179-U Tube-4 Jet-2.



Before JET



After JET

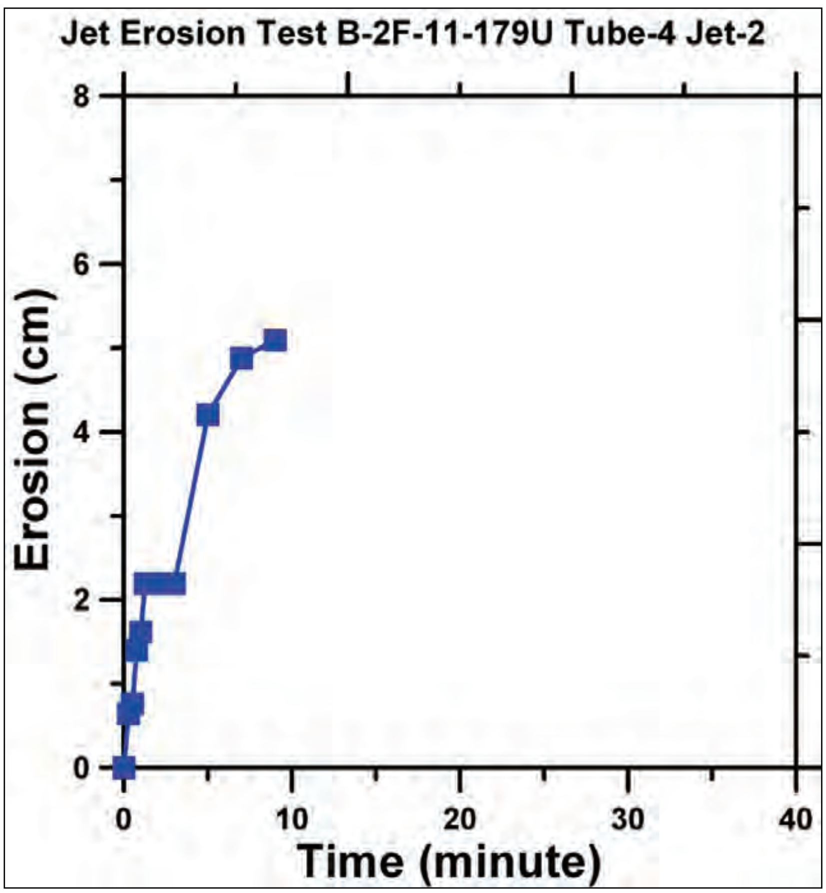
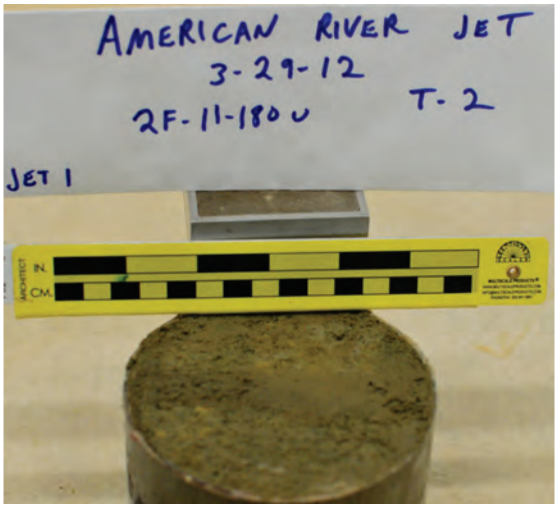
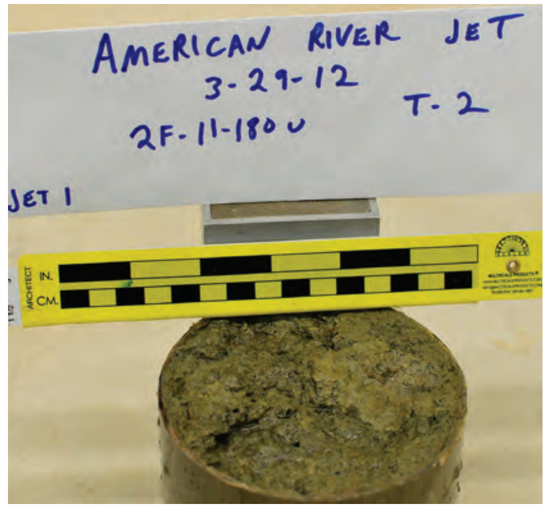


Figure A41. Sample before and after JET with erosion data of Boring 180-U Tube-2 Jet-1.



Before JET



After JET

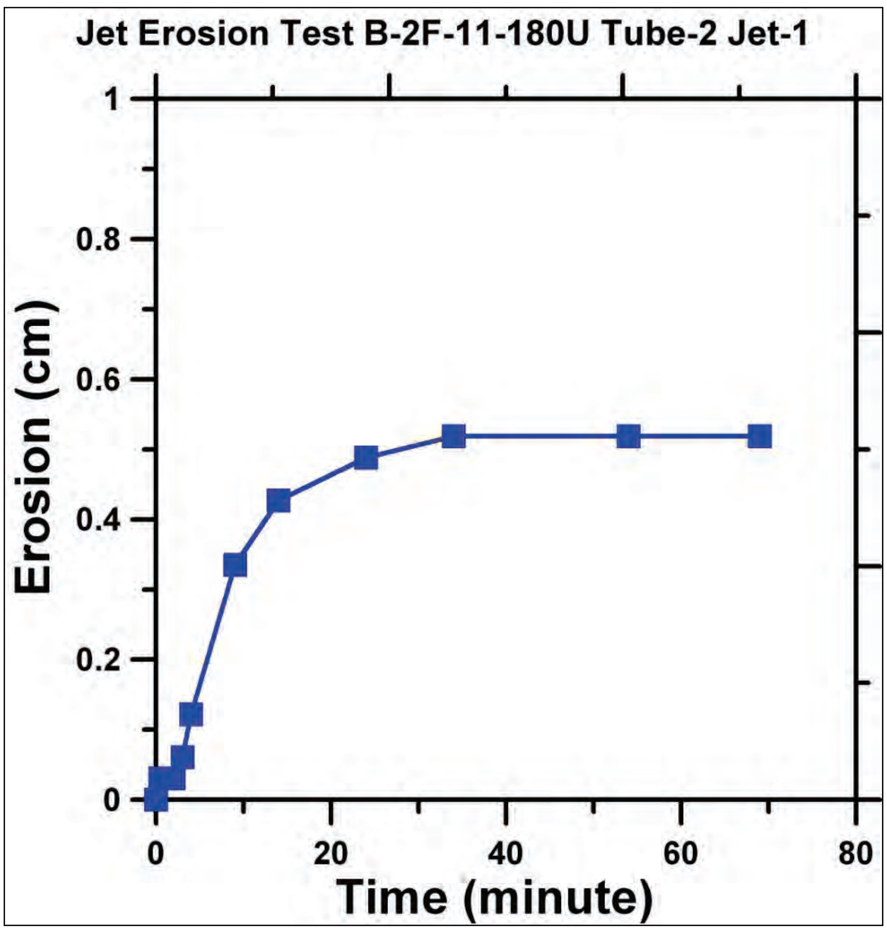
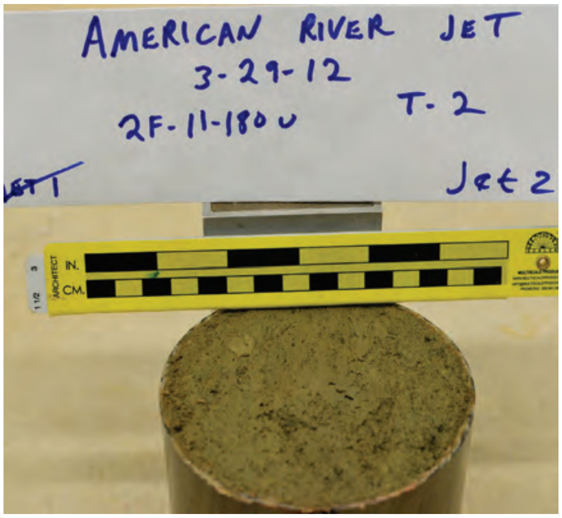
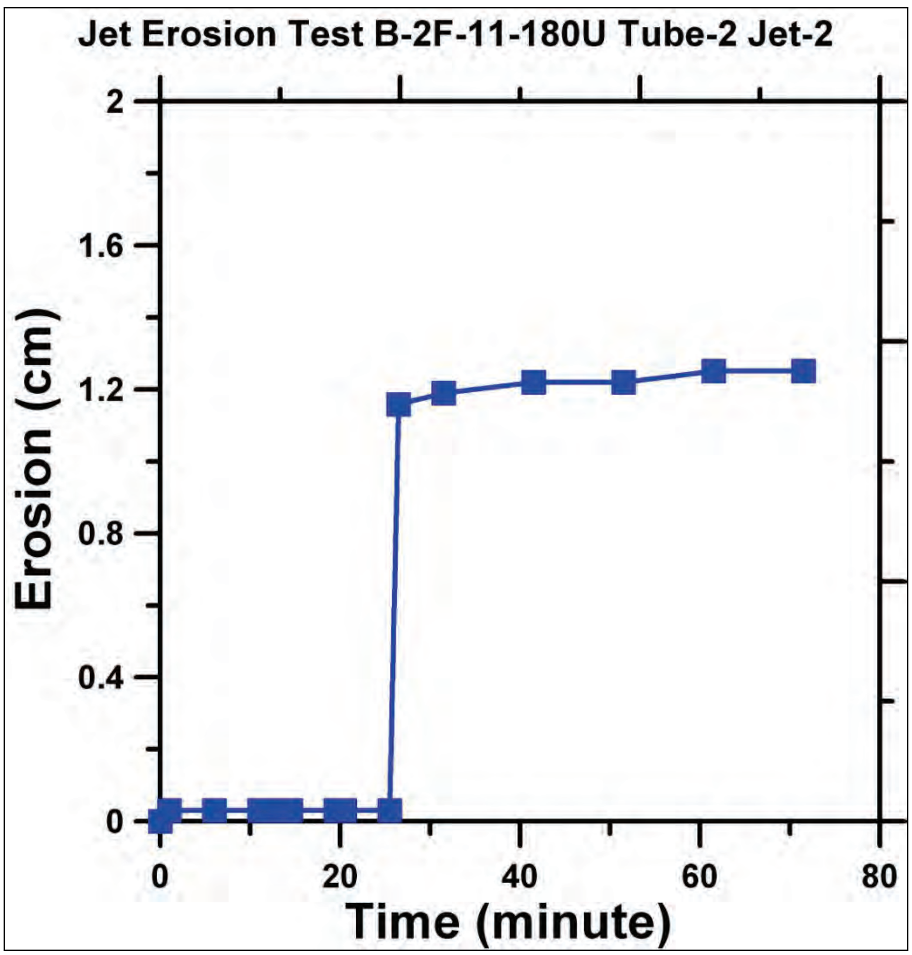


Figure A42. Sample before and after JET with erosion data of Boring 180-U Tube-2 Jet-2.



Before JET After JET



Appendix B: Soil Mechanics Data

Classification and Condition of Lexan Tube Sample

Sheet No.: 1

Date Extruded: 7/23/2012

Project: **Sacramento JET Testing Phase II**

Job No.: **120320**

Boring No.: **2F-11-138U** Sample No.: **T1** Depth, ft.: **25 - 27**

Extruded By: EP/JE

Recovery: 20" (As Denoted on Field Log) Tube Length: 20" (As Measured in Lab)

Depth	Classification and Condition of Sample	Test Assignments
0		
	Bag of Sand (5")	
6"	Wax (1")	
12"	Tan and gray silty fine sand (SM) with mica (14")	
18"		

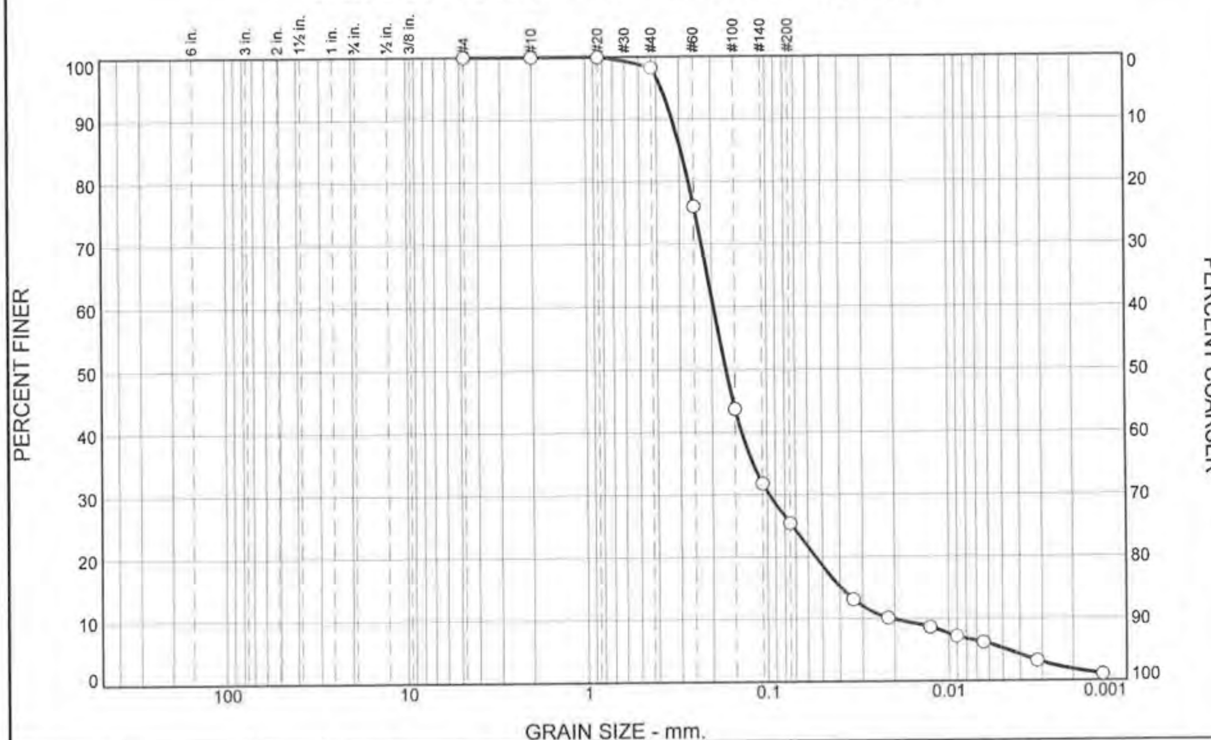
Remarks:

Burns Cooley Dennis, Inc.
Geotechnical and Materials Engineering Consultants

Burns Cooley Dennis, Inc.
551 Sunnybrook Road
Ridgeland, Mississippi 39157
Phone (601)-856-9911
Fax (601)-856-9774

Figure B1. Sample from Boring 2F-11-138U Tube 1 with depth of 25.0 to 27.0 ft.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	1.8	72.8	20.2	5.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	100.0		
#40	98.2		
#60	76.0		
#100	43.7		
#140	31.8		
#200	25.4		
0.0337 mm.	13.1		
0.0217 mm.	10.2		
0.0127 mm.	8.7		
0.0090 mm.	7.2		
0.0064 mm.	6.2		
0.0032 mm.	3.2		
0.0014 mm.	1.1		

* (no specification provided)

Soil Description

Tan and gray silty fine sand (SM) with mica

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.3273 D_{85}= 0.2936 D_{60}= 0.1962
D_{50}= 0.1681 D_{30}= 0.0974 D_{15}= 0.0394
D_{10}= 0.0208 C_u= 9.43 C_c= 2.33

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Source of Sample: 2F-11-138U **Depth:** 25' - 27'
Sample Number: T1 **Date:** 7-27-12

BURNS COOLEY DENNIS, INC. Ridgeland, Mississippi	**Client:** ERDC **Project:** Sacramento JET Testing Phase II **Project No:** 120320 **Figure** 1

Tested By: EP/JE **Checked By:** EP

Classification and Condition of Lexan Tube Sample

Sheet No.: 2

Date Extruded: 7/23/2012

Project: **Sacramento JET Testing Phase II**

Job No.: **120320**

Boring No.: **2F-11-138U** Sample No.: **T4** Depth, ft.: **49 - 51**

Extruded By: EP/JE

Recovery: 20" (As Denoted on Field Log) Tube Length: 16" (As Measured in Lab)

Depth			Classification and Condition of Sample	Test Assignments
0			Bag of Sand (3")	
			Wax (2")	
6"				
12"			Tan and light gray silt (ML), slightly sandy (11")	

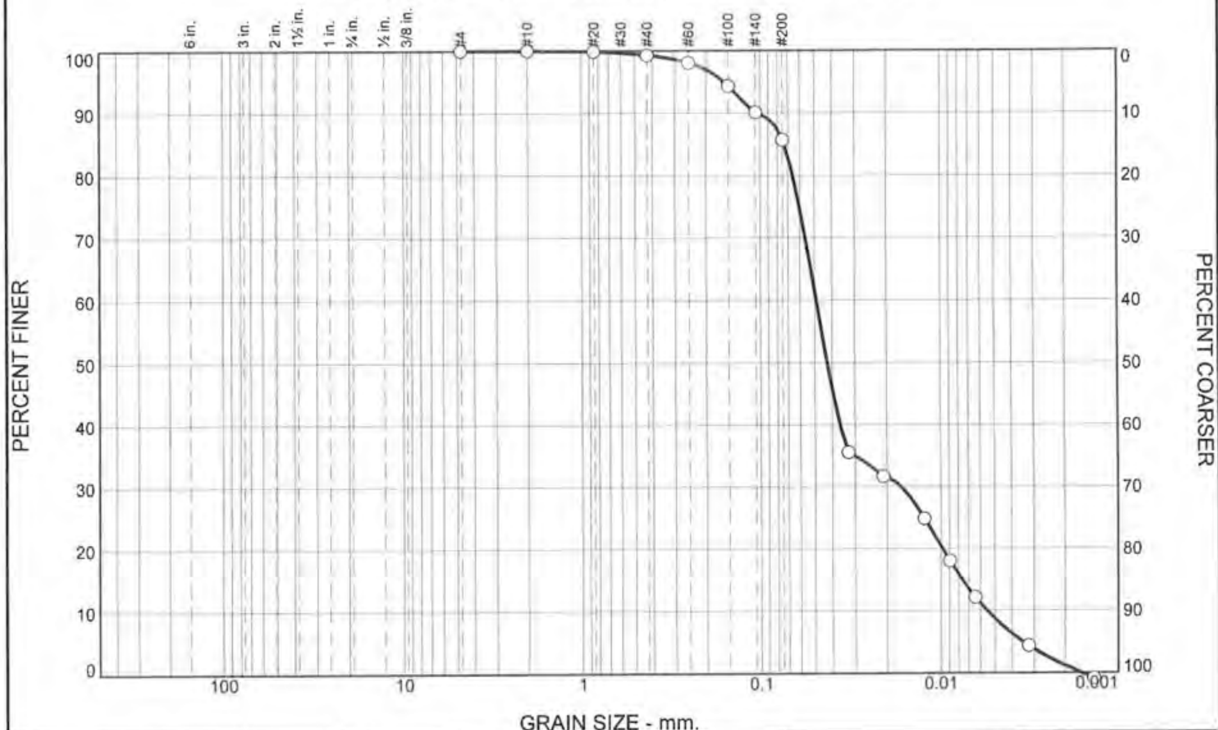
Remarks:

Burns Cooley Dennis, Inc.
Geotechnical and Materials Engineering Consultants

Burns Cooley Dennis, Inc.
551 Sunnybrook Road
Ridgeland, Mississippi 39157
Phone (601)-856-9911
Fax (601)-856-9774

Figure B2. Sample from Boring 2F-11-138U Tube 4 with depth of 49.0 to 51.0 ft.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.7	13.6	77.0	8.7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	99.9		
#40	99.3		
#60	98.1		
#100	94.3		
#140	90.1		
#200	85.7		
0.0326 mm.	35.6		
0.0209 mm.	31.7		
0.0124 mm.	24.8		
0.0089 mm.	18.0		
0.0064 mm.	12.2		
0.0032 mm.	4.4		
0.0014 mm.			

* (no specification provided)

Soil Description

Tan and light gray silt (ML), slightly sandy

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.1047 D_{85}= 0.0736 D_{60}= 0.0490
D_{50}= 0.0426 D_{30}= 0.0168 D_{15}= 0.0076
D_{10}= 0.0055 C_u= 8.87 C_c= 1.04

Classification

USCS= ML AASHTO= A-4(0)

Remarks

Source of Sample: 2F-11-138U **Depth:** 49' - 51'
Sample Number: T4

Date: 7-27-12

BURNS COOLEY DENNIS, INC.

Ridgeland, Mississippi

Client: ERDC
Project: Sacramento JET Testing Phase II
Project No: 120320 **Figure** 2

Tested By: EP/JE **Checked By:** EP

Classification and Condition of Lexan Tube Sample

Sheet No.: 3

Date Extruded: 7/23/2012

Project: **Sacramento JET Testing Phase II**

Job No.: **120320**

Boring No.: **2F-11-139U**

Sample No.: **T4**

Depth, ft.: **46 - 48**

Extruded By: EP/JE

Recovery: 19" (As Denoted on Field Log)

Tube Length: 16" (As Measured in Lab)

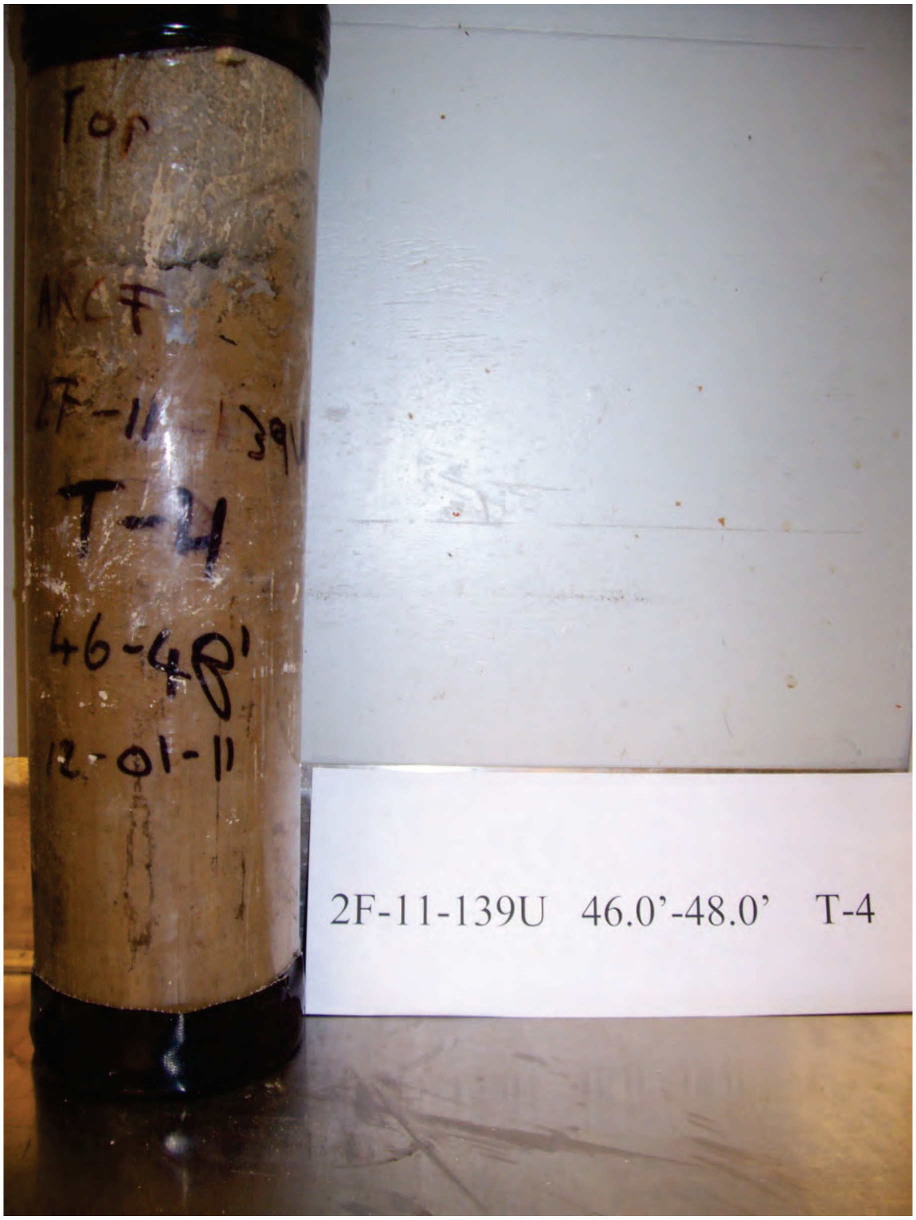
Depth	Classification and Condition of Sample	Test Assignments
0		
	Bag of Sand (4")	
	Wax (1")	
6"		
12"	Tan clayey silt (ML) (11")	

Remarks:

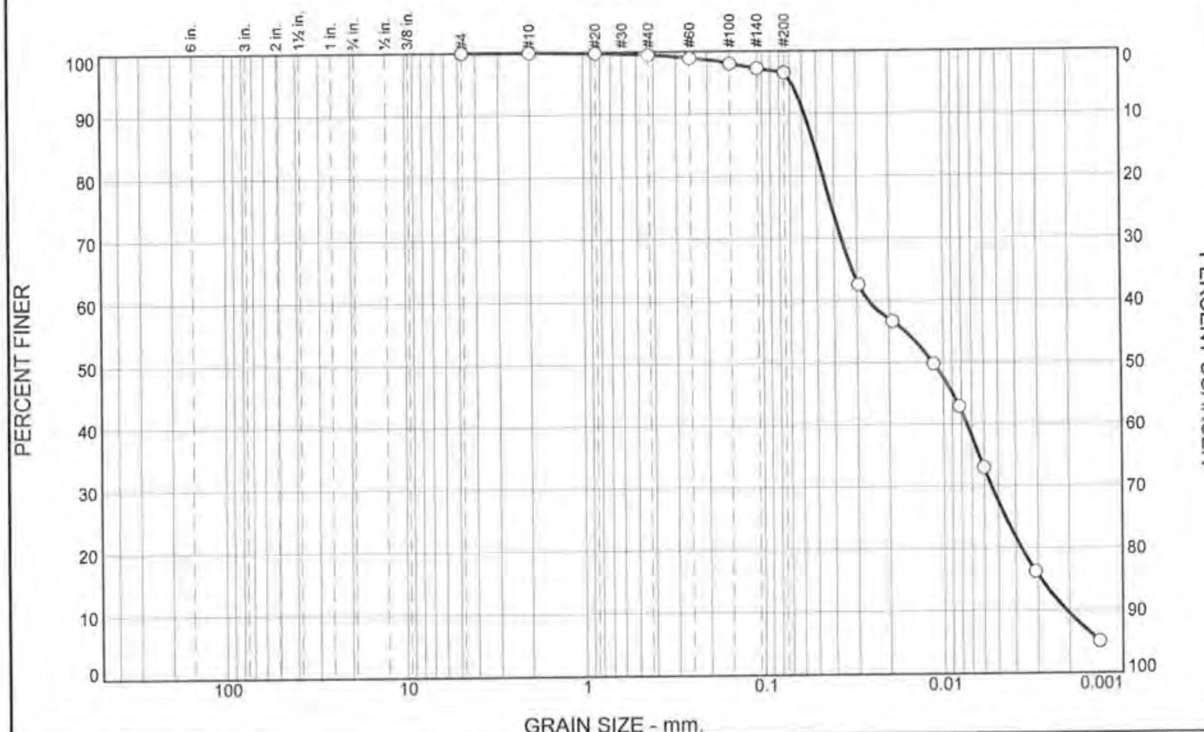
Burns Cooley Dennis, Inc.
Geotechnical and Materials Engineering Consultants

Burns Cooley Dennis, Inc.
551 Sunnybrook Road
Ridgeland, Mississippi 39157
Phone (601)-856-9911
Fax (601)-856-9774

Figure B3. Sample from Boring 2F-11-139U Tube 4 with depth of 46.0 to 48.0 ft.



Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.5	2.9	69.2	27.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	99.8		
#40	99.5		
#60	98.9		
#100	98.0		
#140	97.2		
#200	96.6		
0.0295 mm.	62.6		
0.0191 mm.	56.7		
0.0113 mm.	49.8		
0.0082 mm.	42.9		
0.0060 mm.	33.0		
0.0031 mm.	16.3		
0.0014 mm.	5.1		

* (no specification provided)

Soil Description

Tan clayey silt (ML)

Atterberg Limits

PL= 32 LL= 45 PI= 13

Coefficients

D_{90}= 0.0584 D_{85}= 0.0515 D_{60}= 0.0260
D_{50}= 0.0115 D_{30}= 0.0055 D_{15}= 0.0029
D_{10}= 0.0021 C_u= 12.49 C_c= 0.55

Classification

USCS= ML AASHTO= A-7-5(16)

Remarks

Source of Sample: 2F-11-139U **Depth:** 46' - 48'
Sample Number: T4

Date: 7-27-12

BURNS COOLEY DENNIS, INC.

Ridgeland, Mississippi

Client: ERDC
Project: Sacramento JET Testing Phase II
Project No: 120320 **Figure** 3

Tested By: EP/JE **Checked By:** EP

Classification and Condition of Lexan Tube Sample

Sheet No.: 4

Date Extruded: 7/23/2012

Project: **Sacramento JET Testing Phase II**

Job No.: **120320**

Boring No.: **2F-11-141U** Sample No.: **T1**

Depth, ft.: **25 - 27**

Extruded By: EP/JE

Recovery: 21.5" (As Denoted on Field Log)

Tube Length: 16" (As Measured in Lab)

	Classification and Condition of Sample	Test Assignments
0		
	Bag of Sand (2")	
	Wax (1")	
6"		
	Tan sandy silt (ML) (13")	
12"		

Remarks:

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Geotechnical and Materials Engineering Consultants

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Ridgeland, Mississippi 39157
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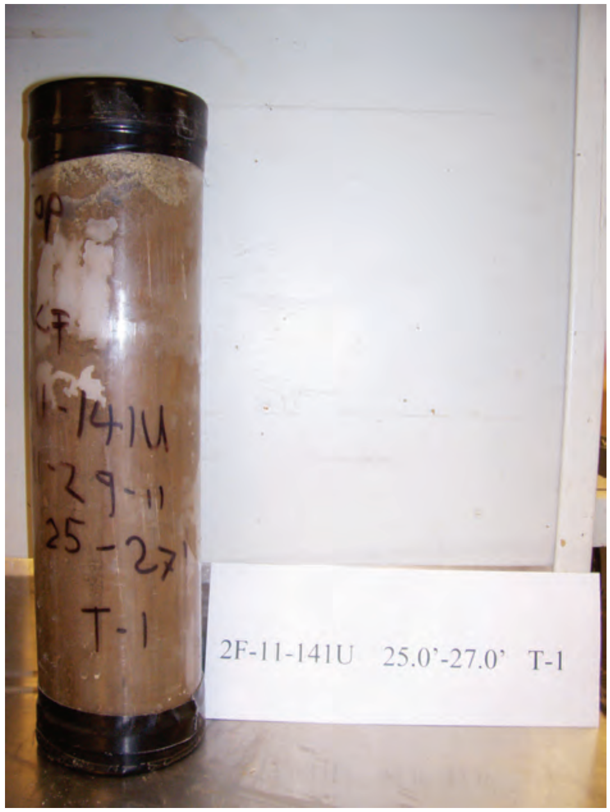
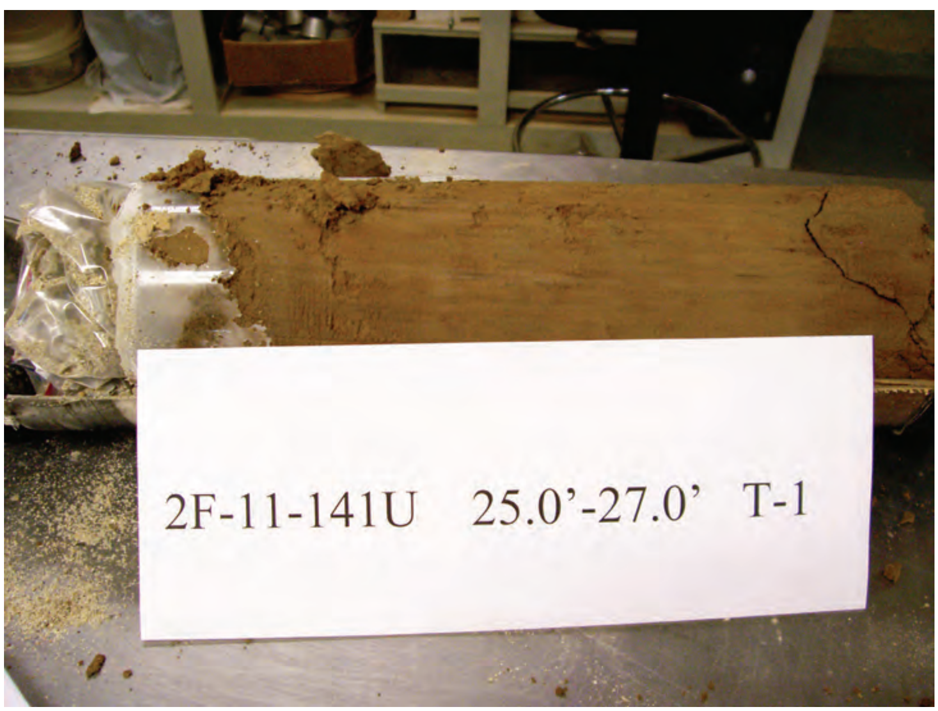
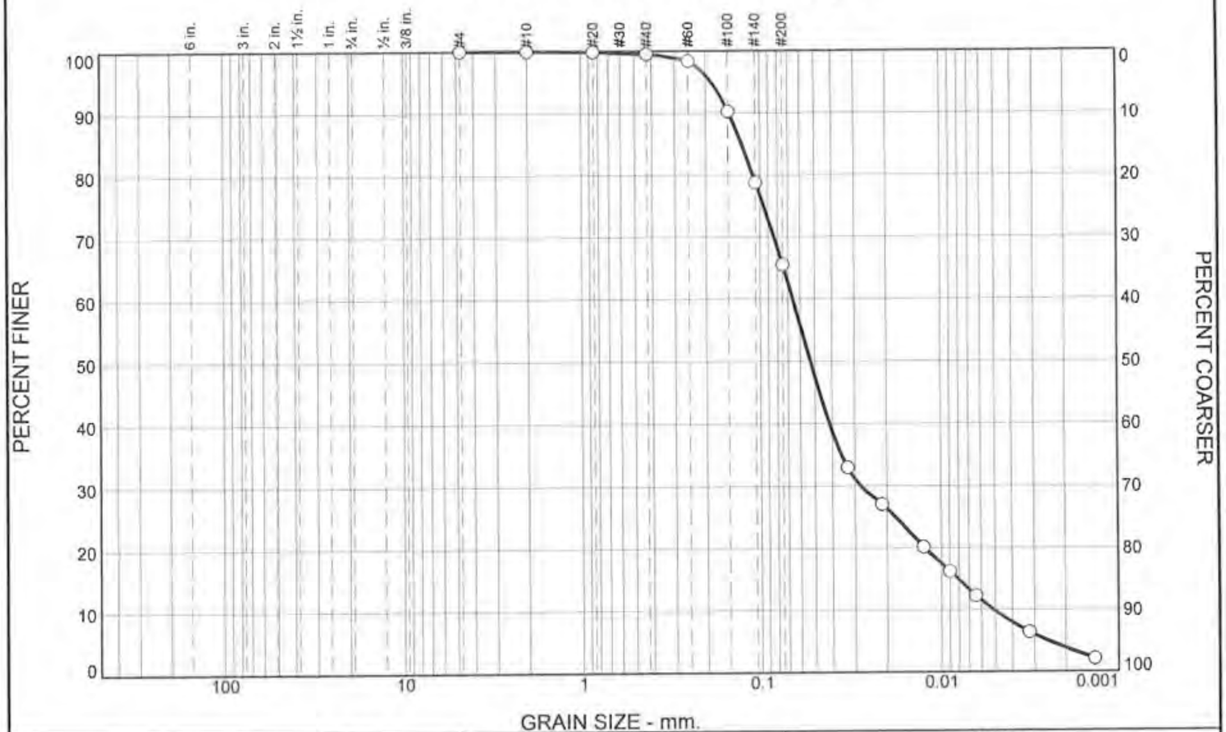
Fax (601)-856-9774

Figure B4. Sample from Boring 2F-11-141U Tube 1 with depth of 25.0 to 27.0 ft.





Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.5	34.0	55.7	9.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	99.9		
#40	99.5		
#60	98.4		
#100	90.3		
#140	78.8		
#200	65.5		
0.0330 mm.	33.0		
0.0213 mm.	27.1		
0.0126 mm.	20.2		
0.0090 mm.	16.3		
0.0064 mm.	12.3		
0.0032 mm.	6.4		
0.0014 mm.	2.1		

* (no specification provided)

Soil Description

Tan sandy silt (ML)

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.1486 D_{85}= 0.1264 D_{60}= 0.0661
D_{50}= 0.0529 D_{30}= 0.0278 D_{15}= 0.0081
D_{10}= 0.0051 C_u= 12.91 C_c= 2.29

Classification

USCS= ML AASHTO= A-4(0)

Remarks

Source of Sample: 2F-11-141U **Depth:** 25' - 27'
Sample Number: T1 **Date:** 7-27-12

BURNS COOLEY DENNIS, INC.
Ridgeland, Mississippi

Client: ERDC
Project: Sacramento JET Testing Phase II
Project No: 120320 **Figure** 4

Tested By: EP/JE **Checked By:** EP

Classification and Condition of Lexan Tube Sample

Sheet No.: 5

Date Extruded: 7/23/2012

Project: **Sacramento JET Testing Phase II**

Job No.: **120320**

Boring No.: **2F-11-141U** Sample No.: **T3**

Depth, ft.: **46.5 - 48.5**

Extruded By: EP/JE

Recovery: 16" (As Denoted on Field Log) Tube Length: 24" (As Measured in Lab)

0	Classification and Condition of Sample	Test Assignments
	Bag of Sand (4")	
6"	Wax (1")	
12"		
	Tan silt (MH) (19")	
18"		
24"		

Remarks:

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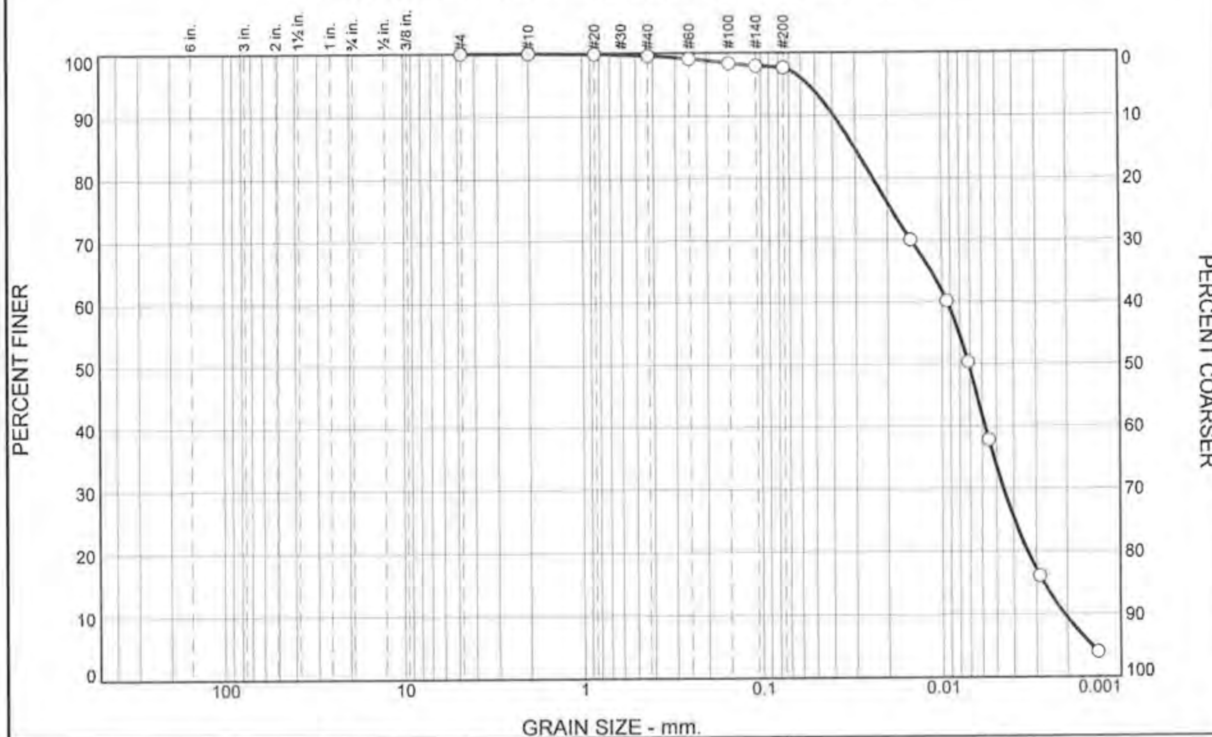
Figure B5. Sample from Boring 2F-11-141U Tube 3 with depth of 46.5 to 48.5 ft.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.4	2.0	64.1	33.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	99.9		
#40	99.6		
#60	99.1		
#100	98.3		
#140	97.9		
#200	97.6		
0.0149 mm.	70.0		
0.0094 mm.	60.2		
0.0072 mm.	50.3		
0.0055 mm.	37.8		
0.0029 mm.	16.1		
0.0013 mm.	4.0		

* (no specification provided)

Soil Description

Tan silt (MH)

Atterberg Limits

PL= 37 LL= 51 PI= 14

Coefficients

D_{90}= 0.0394 D_{85}= 0.0305 D_{60}= 0.0094
D_{50}= 0.0071 D_{30}= 0.0046 D_{15}= 0.0027
D_{10}= 0.0021 C_u= 4.50 C_c= 1.08

Classification

USCS= MH AASHTO= A-7-5(19)

Remarks

Source of Sample: 2F-11-141U **Depth:** 46.5' - 48.5'
Sample Number: T3 **Date:** 7-27-12

BURNS COOLEY DENNIS, INC.	**Client:** ERDC
	Project: Sacramento JET Testing Phase II
Ridgeland, Mississippi	**Project No:** 120320 **Figure** 5

Tested By: EP/JE **Checked By:** EP

Classification and Condition of Lexan Tube Sample

Sheet No.: 6

Date Extruded: 7/23/2012

Project: **Sacramento JET Testing Phase II**

Job No.: **120320**

Boring No.: **2F-11-142U** Sample No.: **T3** Depth, ft.: **35 - 37**

Extruded By: EP/JE

Recovery: 23" (As Denoted on Field Log) Tube Length: 16" (As Measured in Lab)

	Classification and Condition of Sample	Test Assignments
0	Wax (2")	
6"		
	Tan and red silt (ML) with sand (14")	
12"		

Remarks:

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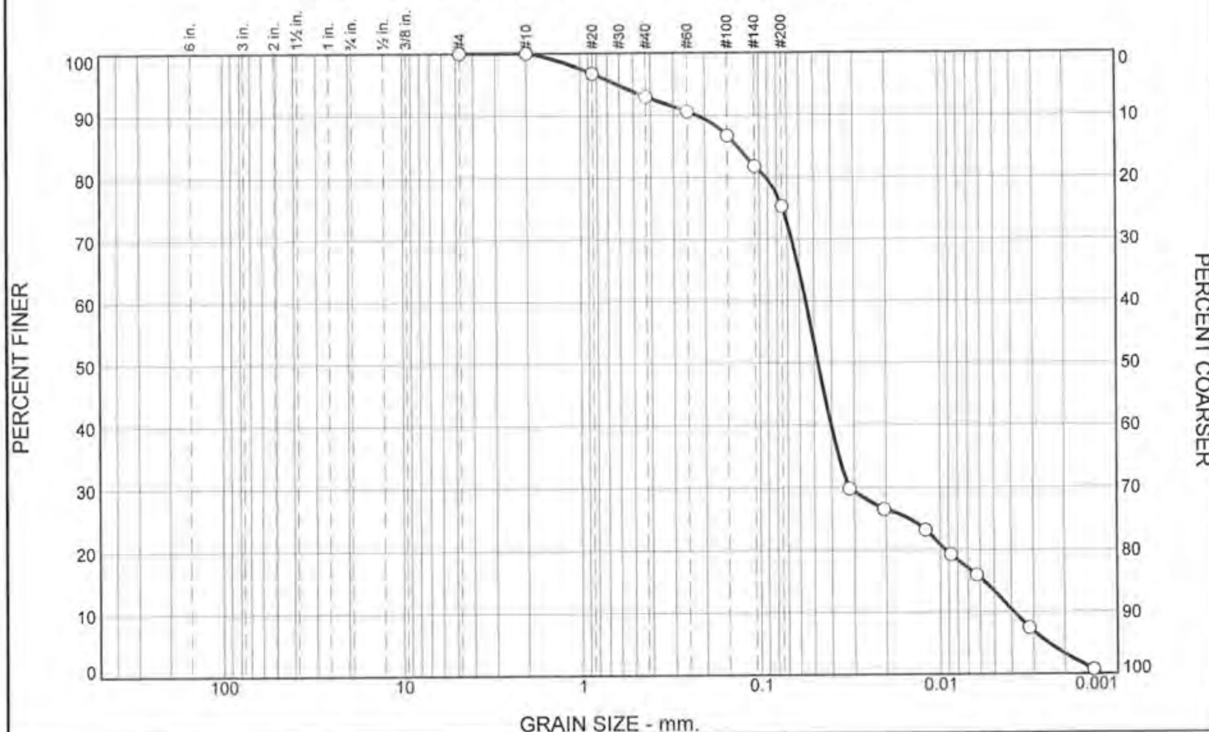
Figure B6. Sample from Boring 2F-11-142U Tube 3 with depth of 35.0 to 37.0 ft.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	7.0	17.7	61.9	13.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	96.7		
#40	93.0		
#60	90.6		
#100	86.7		
#140	81.8		
#200	75.3		
0.0319 mm.	29.8		
0.0206 mm.	26.5		
0.0121 mm.	23.2		
0.0087 mm.	19.2		
0.0062 mm.	16.0		
0.0032 mm.	7.5		
0.0014 mm.	0.7		

* (no specification provided)

Soil Description

Tan and red silt (ML) with sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.2221 D_{85}= 0.1323 D_{60}= 0.0555
D_{50}= 0.0475 D_{30}= 0.0321 D_{15}= 0.0057
D_{10}= 0.0039 C_u= 14.33 C_c= 4.80

Classification

USCS= ML AASHTO= A-4(0)

Remarks

Source of Sample: 2F-11-142U **Depth:** 35' - 37'
Sample Number: T3

Date: 7-30-12

BURNS COOLEY DENNIS, INC.
Ridgeland, Mississippi

Client: ERDC
Project: Sacramento JET Testing Phase II
Project No: 120320 **Figure** 6

Tested By: EP/JE **Checked By:** EP

Classification and Condition of Lexan Tube Sample

Sheet No.: 7

Date Extruded: 7/23/2012

Project: **Sacramento JET Testing Phase II**

Job No.: **120320**

Boring No.: **2F-11-143U** Sample No.: **T3** Depth, ft.: **33 - 35**

Extruded By: EP/JE

Recovery: ? (As Denoted on Field Log) Tube Length: 16" (As Measured in Lab)

Depth			Classification and Condition of Sample	Test Assignments
0			Wax (1")	
6"			Tan and red silty fine sand (SM) (9")	
12"			Tan and red silt (ML), slightly clayey, with sand (6")	

Remarks:

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Figure B7. Sample from Boring 2F-11-143U Tube 3 with depth of 33.0 to 35.0 ft.

Particle Size Distribution Report

% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	5.4	10.8	63.7	20.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	97.5		
#40	94.6		
#60	92.6		
#100	88.9		
#140	85.8		
#200	83.8		
0.0260 mm.	59.6		
0.0176 mm.	51.1		
0.0111 mm.	37.4		
0.0083 mm.	28.9		
0.0061 mm.	20.4		
0.0030 mm.	19.2		
0.0014 mm.	1.3		

* (no specification provided)

Soil Description

Tan and red silt (ML), slightly clayey, with sand

Atterberg Limits

PL= 31 LL= 36 PI= 5

Coefficients

D_{90}= 0.1701 D_{85}= 0.0900 D_{60}= 0.0265
D_{50}= 0.0169 D_{30}= 0.0086 D_{15}= 0.0022
D_{10}= 0.0018 C_u= 14.58 C_c= 1.52

Classification

USCS= ML AASHTO= A-4(5)

Remarks

Source of Sample: 2F-11-143U **Depth:** 33' - 35'
Sample Number: T3 **Date:** 7-30-12

BURNS COOLEY DENNIS, INC. Ridgeland, Mississippi	Client: ERDC Project: Sacramento JET Testing Phase II Project No: 120320 Figure 7

Tested By: EP/JE **Checked By:** EP

Classification and Condition of Lexan Tube Sample

Sheet No.: 8

Date Extruded: 7/23/2012

Project: **Sacramento JET Testing Phase II**

Job No.: **120320**

Boring No.: **2F-11-144U** Sample No.: **T1**

Depth, ft.: **46 - 48**

Extruded By: EP/JE

Recovery: 14" (As Denoted on Field Log) Tube Length: 16" (As Measured in Lab)

Depth	Classification and Condition of Sample	Test Assignments
0		
	Bag of Sand (6")	
6"	Wax (1")	
	Cobble Stone (3")	
12"	Tan silty clay (CL), with sand (6")	

Remarks:

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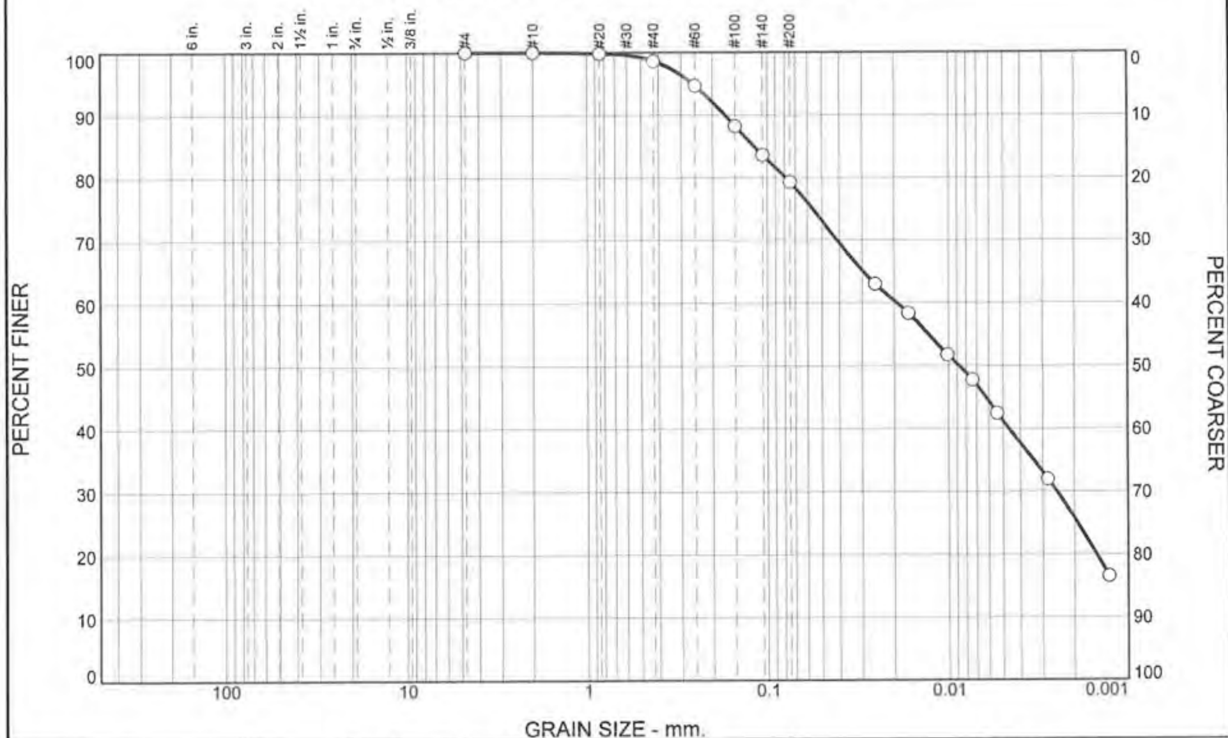
Figure B8. Sample from Boring 2F-11-144U Tube-1 with depth of 46.0 to 48.0 ft.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	1.4	19.3	38.1	41.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	99.8		
#40	98.6		
#60	94.7		
#100	88.2		
#140	83.6		
#200	79.3		
0.0254 mm.	63.0		
0.0167 mm.	58.4		
0.0101 mm.	51.7		
0.0074 mm.	47.8		
0.0054 mm.	42.5		
0.0028 mm.	32.0		
0.0013 mm.	16.6		

* (no specification provided)

Soil Description

Tan silty clay (CL) with sand

Atterberg Limits

PL= 24 LL= 38 PI= 14

Coefficients

D_{90}= 0.1709 D_{85}= 0.1179 D_{60}= 0.0194
D_{50}= 0.0088 D_{30}= 0.0025 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(11)

Remarks

Source of Sample: 2F-11-144U **Depth:** 46' - 48'
Sample Number: T1 **Date:** 7-30-12

BURNS COOLEY DENNIS, INC. Ridgeland, Mississippi	Client: ERDC Project: Sacramento JET Testing Phase II Project No: 120320 Figure 8

Tested By: EP/JE **Checked By:** EP

Classification and Condition of Lexan Tube Sample

Sheet No.: 9

Date Extruded: 7/23/2012

Project: **Sacramento JET Testing Phase II**

Job No.: **120320**

Boring No.: **2F-11-145U** Sample No.: **T2** Depth, ft.: **48 - 50**

Extruded By: EP/JE

Recovery: 15" (As Denoted on Field Log) Tube Length: 16" (As Measured in Lab)

Depth	Classification and Condition of Sample	Test Assignments
0		
	Bag of Sand (6")	
6"	Wax (1")	
	Embedded Cobblestone (2")	
12"	Tan and light gray clayey silt (ML), with sand (7")	

Remarks:

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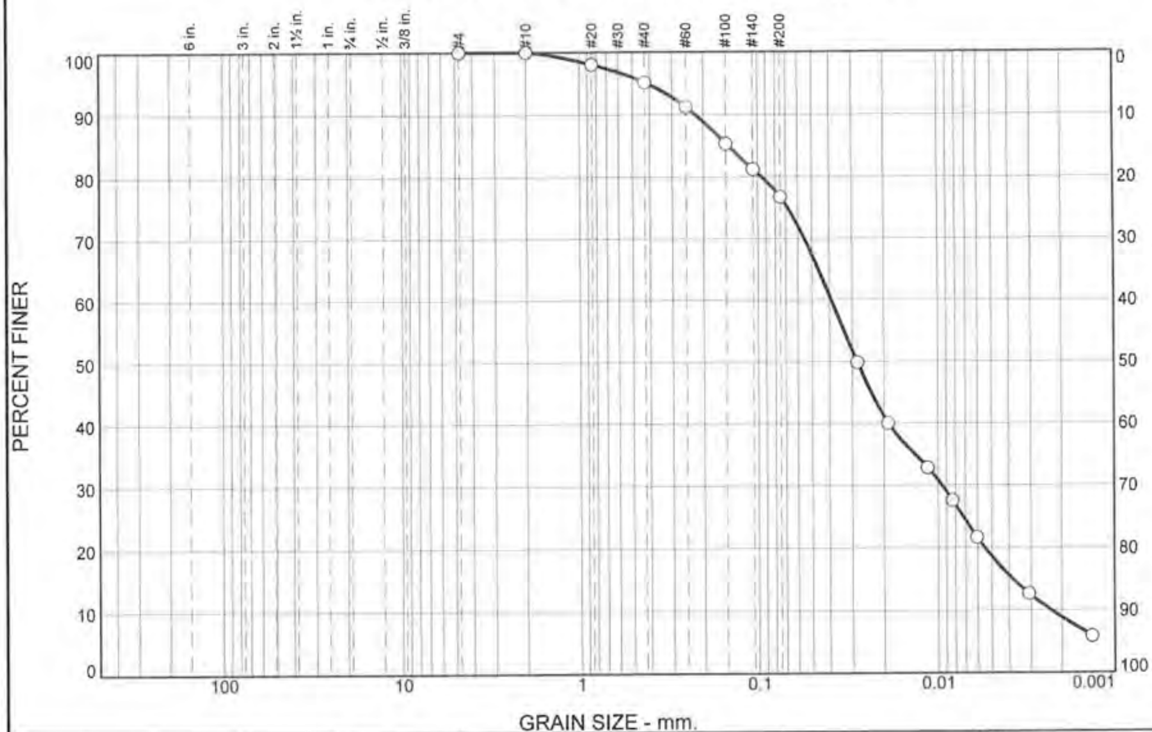
Figure B9. Sample from Boring 2F-11-145U Tube 2 with depth of 48.0 to 50.0 ft.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	4.9	18.3	58.2	18.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	98.0		
#40	95.1		
#60	91.2		
#100	85.4		
#140	81.2		
#200	76.8		
0.0280 mm.	49.8		
0.0189 mm.	40.0		
0.0114 mm.	32.8		
0.0083 mm.	27.6		
0.0061 mm.	21.7		
0.0031 mm.	12.7		
0.0013 mm.	5.9		

* (no specification provided)

Soil Description

Tan and light gray clayey silt (ML) with sand

Atterberg Limits

PL= 30 LL= 49 PI= 19

Coefficients

D_{90}= 0.2220 D_{85}= 0.1456 D_{60}= 0.0391
D_{50}= 0.0282 D_{30}= 0.0095 D_{15}= 0.0038
D_{10}= 0.0023 C_u= 16.95 C_c= 1.00

Classification

USCS= ML AASHTO= A-7-5(16)

Remarks

Source of Sample: 2F-11-145U **Depth:** 48' - 50'
Sample Number: T2 **Date:** 7-30-12

BURNS COOLEY DENNIS, INC.
Ridgeland, Mississippi

Client: ERDC
Project: Sacramento JET Testing Phase II
Project No: 120320 **Figure** 9

Tested By: EP/JE **Checked By:** EP

Classification and Condition of Lexan Tube Sample

Sheet No.: 10

Date Extruded: 7/23/2012

Project: **Sacramento JET Testing Phase II**

Job No.: **120320**

Boring No.: **2F-11-148U** Sample No.: **T2** Depth, ft.: **36 - 38**

Extruded By: EP/JE

Recovery: ? (As Denoted on Field Log) Tube Length: 11" (As Measured in Lab)

Depth			Classification and Condition of Sample	Test Assignments
0			Hard tan silty clay (CL) slightly sandy, with mica (3")	
6"			Tan sandy silt (ML), with mica (8")	

Remarks:

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Ridgeland, Mississippi 39157
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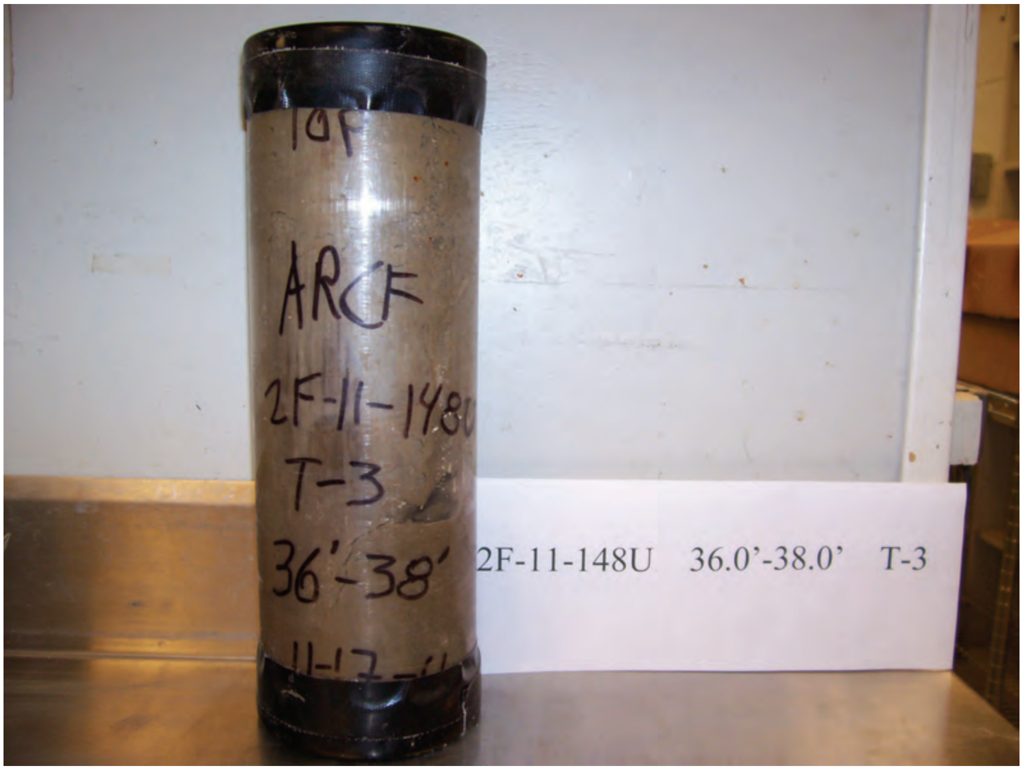
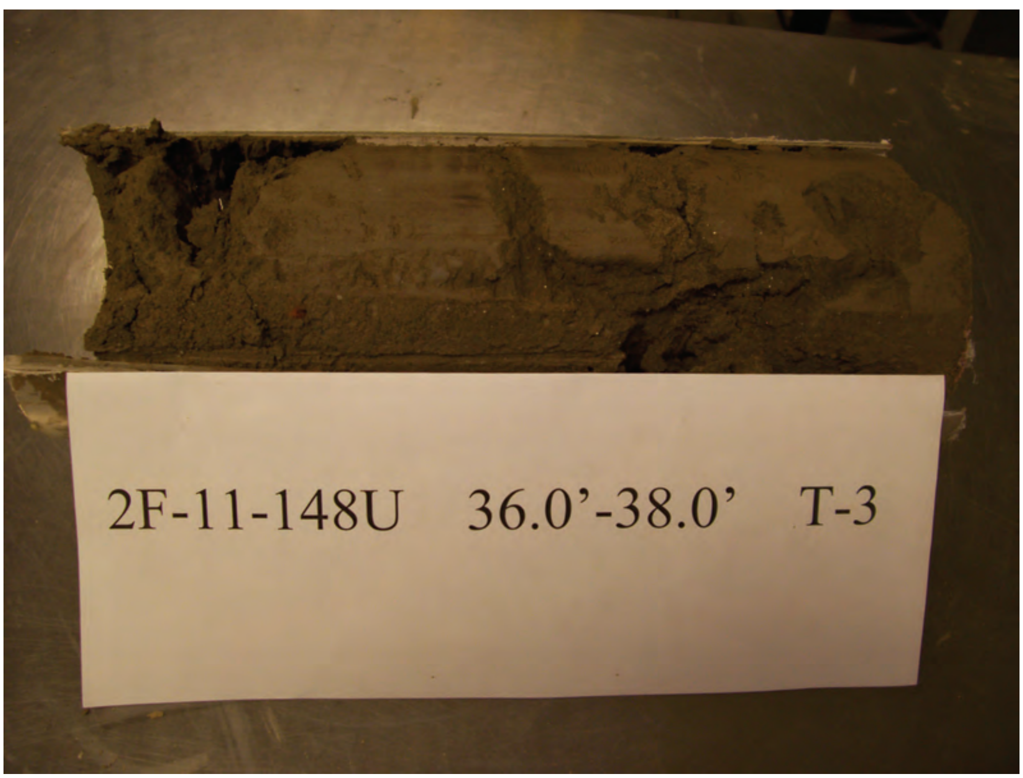
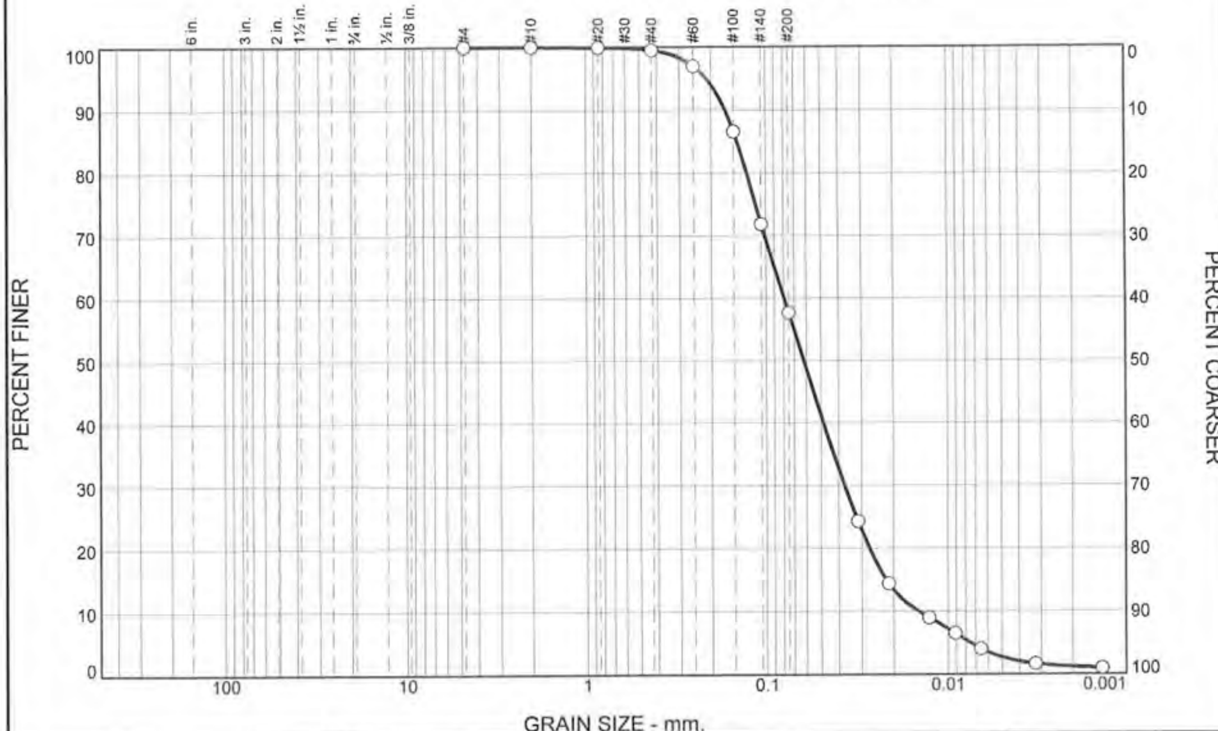
Figure B10. Sample from Boring 2F-11-148U Tube 3 with depth of 36.0 to 38.0 ft.





Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.5	41.8	55.0	2.7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	99.9		
#40	99.5		
#60	97.0		
#100	86.6		
#140	71.8		
#200	57.7		
0.0314 mm.	24.3		
0.0213 mm.	14.4		
0.0127 mm.	9.0		
0.0091 mm.	6.5		
0.0066 mm.	4.1		
0.0032 mm.	1.7		
0.0014 mm.	1.0		

* (no specification provided)

Soil Description

Tan sandy silt (ML) with mica

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.1670 D_{85}= 0.1436 D_{60}= 0.0795
D_{50}= 0.0620 D_{30}= 0.0372 D_{15}= 0.0220
D_{10}= 0.0146 C_u= 5.43 C_c= 1.19

Classification

USCS= ML AASHTO= A-4(0)

Remarks

Source of Sample: 2F-11-148U **Depth:** 36' - 38'
Sample Number: T2 **Date:** 7-30-12

BURNS COOLEY DENNIS, INC.

Ridgeland, Mississippi

Client: ERDC
Project: Sacramento JET Testing Phase II
Project No: 120320 **Figure** 10

Tested By: EP/JE **Checked By:** EP

Classification and Condition of Lexan Tube Sample

Sheet No.: 11

Date Extruded: 7/23/2012

Project: **Sacramento JET Testing Phase II**

Job No.: **120320**

Boring No.: **2F-11-149U** Sample No.: **T2** Depth, ft.: **27 - 29**

Extruded By: EP/JE

Recovery: 15" (As Denoted on Field Log) Tube Length: 24" (As Measured in Lab)

Depth	Classification and Condition of Sample	Test Assignments
0 – 6" – 9"	Gravel (9")	
9" – 12"	Wax (3")	
12" – 24"	Tan and light gray silt (ML), with sand (11")	

Remarks:

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Geotechnical and Materials Engineering Consultants

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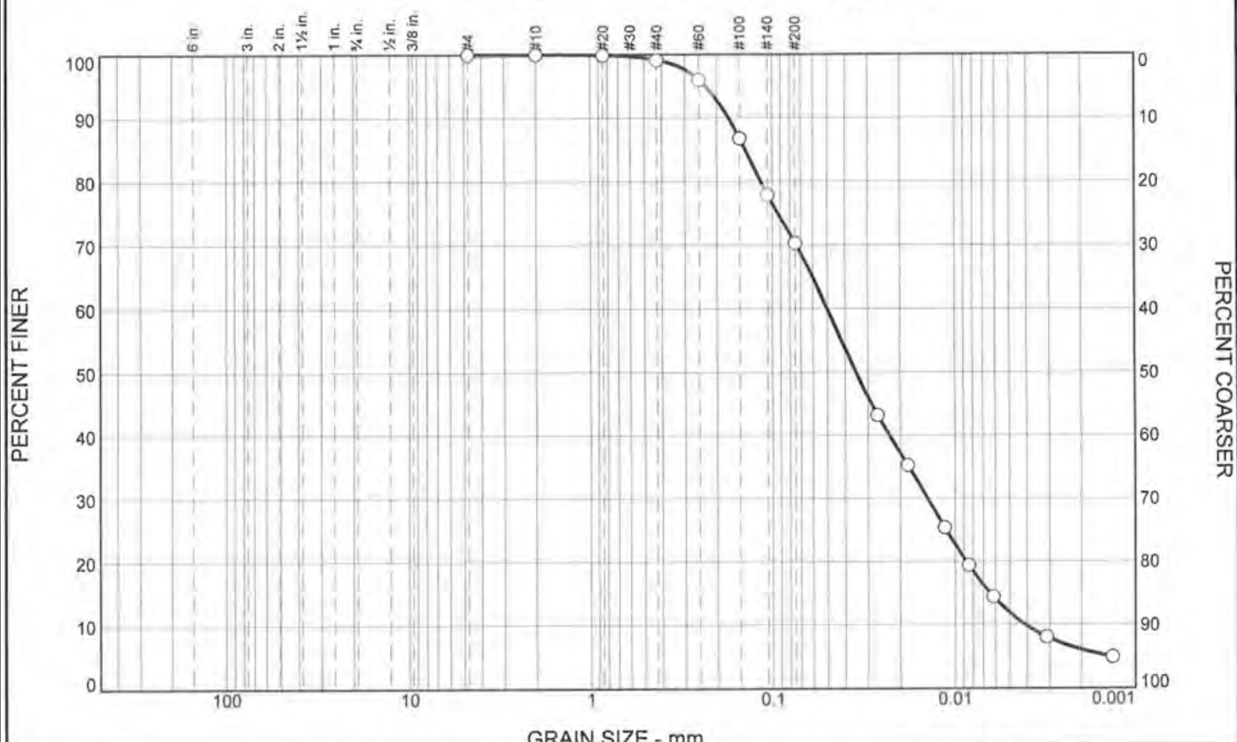
Figure B11. Sample from Boring 2F-11-149U Tube 2 with depth of 27.0 to 29.0 ft.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.9	28.8	58.4	11.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	99.9		
#40	99.1		
#60	96.0		
#100	86.8		
#140	77.8		
#200	70.3		
0.0267 mm.	43.2		
0.0182 mm.	35.3		
0.0114 mm.	25.3		
0.0084 mm.	19.4		
0.0062 mm.	14.4		
0.0031 mm.	8.1		
0.0013 mm.	4.9		

* (no specification provided)

Soil Description

Tan and light gray silt (ML) with sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.1728 D_{85}= 0.1399 D_{60}= 0.0501
D_{50}= 0.0349 D_{30}= 0.0142 D_{15}= 0.0064
D_{10}= 0.0041 C_u= 12.20 C_c= 0.98

Classification

USCS= ML AASHTO= A-4(0)

Remarks

Source of Sample: 2F-11-149U **Depth:** 27'- 29'
Sample Number: T2 **Date:** 7-31-12

BURNS COOLEY DENNIS, INC.

Ridgeland, Mississippi

Client: ERDC
Project: Sacramento JET Testing Phase II
Project No: 120320 **Figure** 11

Tested By: EP/JE **Checked By:** EP

Classification and Condition of Lexan Tube Sample

Sheet No.: 12

Date Extruded: 7/23/2012

Project: **Sacramento JET Testing Phase II**

Job No.: **120320**

Boring No.: **2F-11-151U** Sample No.: **T2** Depth, ft.: **26 - 28**

Extruded By: EP/JE

Recovery: 19 (As Denoted on Field Log) Tube Length: 20" (As Measured in Lab)

Depth	Classification and Condition of Sample	Test Assignments
0		
	Gravel (6")	
6"	Wax (1")	
12"	Tan silty fine to medium sand (SM) with mica (13")	
18"		

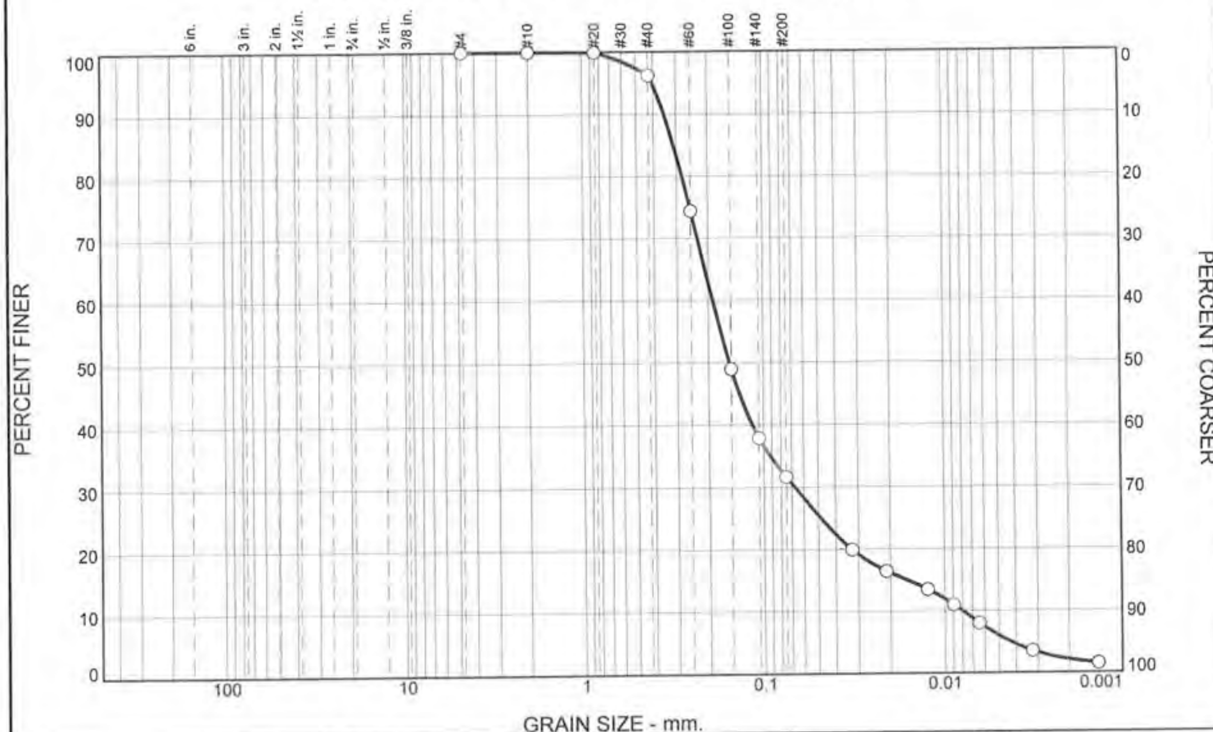
Remarks:

Burns Cooley Dennis, Inc.
Geotechnical and Materials Engineering Consultants

Burns Cooley Dennis, Inc. 551 Sunnybrook Road Ridgeland, Mississippi 39157 Phone (601)-856-9911 Fax (601)-856-9774

Figure B12. Sample from Boring 2F-11-151U Tube 2 with depth of 26.0 to 28.0 ft.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	3.8	64.5	25.7	6.0

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	99.9		
#40	96.2		
#60	74.4		
#100	49.0		
#140	37.9		
#200	31.7		
0.0325 mm.	19.9		
0.0211 mm.	16.4		
0.0124 mm.	13.5		
0.0089 mm.	11.0		
0.0064 mm.	8.0		
0.0032 mm.	3.5		
0.0014 mm.	1.5		

* (no specification provided)

Soil Description

Tan silty fine to medium sand (SM) with mica

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.3496 D_{85}= 0.3104 D_{60}= 0.1899
D_{50}= 0.1538 D_{30}= 0.0673 D_{15}= 0.0163
D_{10}= 0.0080 C_u= 23.73 C_c= 2.98

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Source of Sample: 2F-11-151U **Depth:** 26' - 28'
Sample Number: T2 **Date:** 7-31-12

BURNS COOLEY DENNIS, INC. Ridgeland, Mississippi	Client: ERDC Project: Sacramento JET Testing Phase II Project No: 120320 Figure 12

Tested By: EP/JE **Checked By:** EP

Classification and Condition of Lexan Tube Sample

Sheet No.: 13

Date Extruded: 7/23/2012

Project: **Sacramento JET Testing Phase II**

Job No.: **120320**

Boring No.: **2F-11-152U** Sample No.: **T2** Depth, ft.: **25 - 27**

Extruded By: EP/JE

Recovery: 16" (As Denoted on Field Log) Tube Length: 16" (As Measured in Lab)

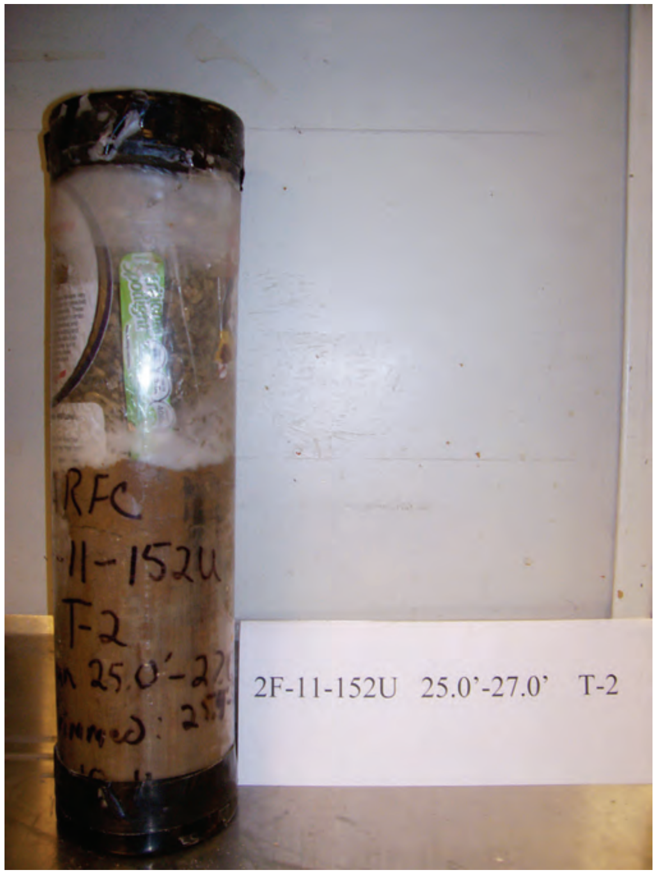
Depth	Classification and Condition of Sample	Test Assignments
0		
6"	Bag of Gravel (8")	
	Wax (1")	
12"	Tan and light gray silt (ML) with sand (7")	

Remarks:

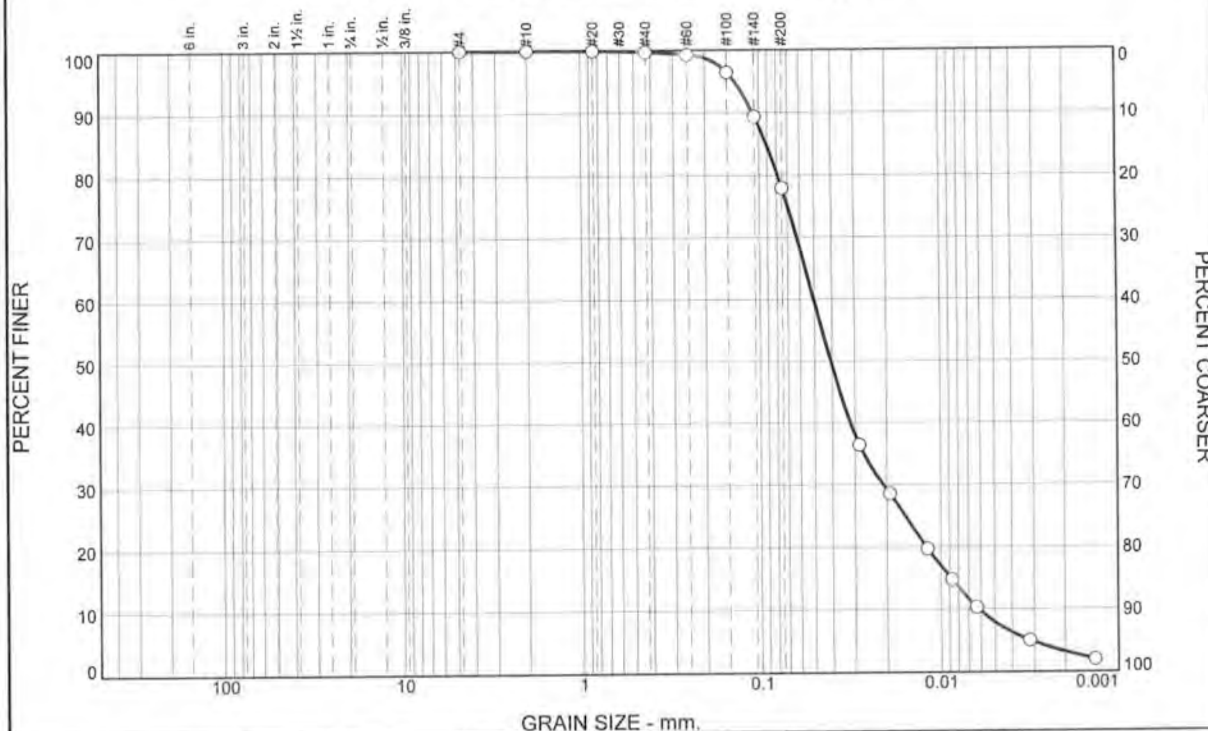
Burns Cooley Dennis, Inc.
Geotechnical and Materials Engineering Consultants

Burns Cooley Dennis, Inc.
551 Sunnybrook Road
Ridgeland, Mississippi 39157
Phone (601)-856-9911
Fax (601)-856-9774

Figure B13. Sample from Boring 2F-11-152U Tube 1 with depth of 25.0 to 27.0 ft.



Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.3	21.7	70.0	8.0

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	99.9		
#40	99.7		
#60	99.3		
#100	96.4		
#140	89.4		
#200	78.0		
0.0284 mm.	36.4		
0.0192 mm.	28.5		
0.0119 mm.	19.7		
0.0087 mm.	14.8		
0.0063 mm.	10.4		
0.0032 mm.	5.1		
0.0014 mm.	2.0		

* (no specification provided)

Soil Description

Tan and light gray silt (ML) with sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.1085 D_{85}= 0.0913 D_{60}= 0.0505
D_{50}= 0.0407 D_{30}= 0.0209 D_{15}= 0.0088
D_{10}= 0.0061 C_u= 8.24 C_c= 1.42

Classification

USCS= ML AASHTO= A-4(0)

Remarks

Source of Sample: 2F-11-152U **Depth:** 25' - 27'
Sample Number: T2 **Date:** 7-31-12

BURNS COOLEY DENNIS, INC.

Ridgeland, Mississippi

Client: ERDC
Project: Sacramento JET Testing Phase II
Project No: 120320 **Figure** 13

Tested By: EP/JE **Checked By:** EP

Classification and Condition of Lexan Tube Sample

Sheet No.: 14

Date Extruded: 7/23/2012

Project: **Sacramento JET Testing Phase II**

Job No.: **120320**

Boring No.: **2F-11-171U** Sample No.: **T4** Depth, ft.: **45 - 47**

Extruded By: EP/JE

Recovery: 15" (As Denoted on Field Log) Tube Length: 24" (As Measured in Lab)

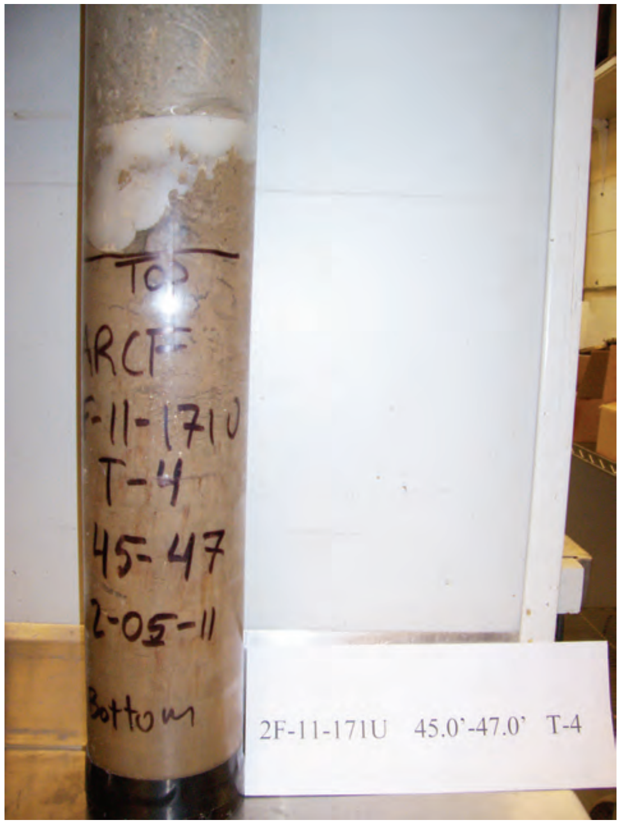
Depth	Classification and Condition of Sample	Test Assignments
0		
0–7"	Bag of Sand (7")	
6"		
7–8"	Wax (1")	
12"		
8–24"	Tan silty clay (CL) with sand and mica (16")	
18"		
24"		

Remarks:

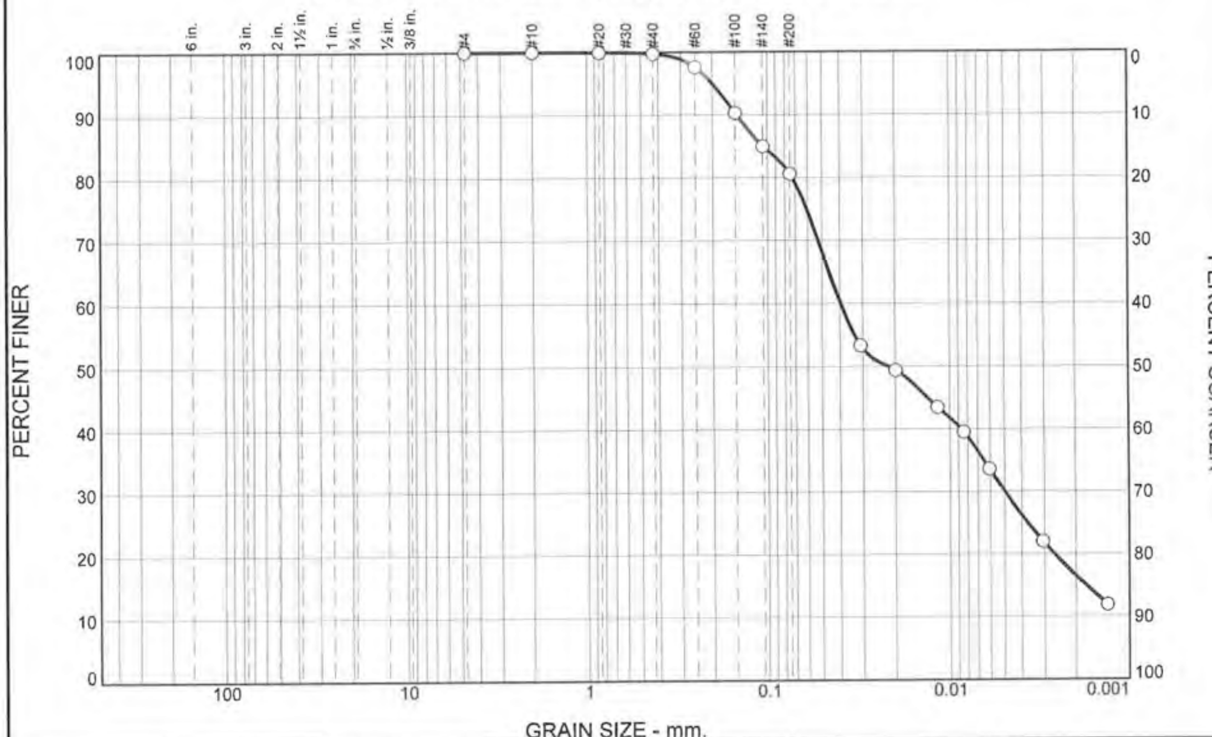
Burns Cooley Dennis, Inc.
Geotechnical and Materials Engineering Consultants

Burns Cooley Dennis, Inc.
551 Sunnybrook Road
Ridgeland, Mississippi 39157
Phone (601)-856-9911
Fax (601)-856-9774

Figure B14. Sample from Boring 2F-11-171U Tube 4 with depth of 45.0 to 47.0 ft.



Particle Size Distribution Report



% +3"	% Gravel Coarse	% Gravel Fine	% Sand Coarse	% Sand Medium	% Sand Fine	% Fines Silt	% Fines Clay
0.0	0.0	0.0	0.0	0.3	19.1	50.6	30.0

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	100.0		
#40	99.7		
#60	97.6		
#100	90.3		
#140	85.0		
#200	80.6		
0.0309 mm.	53.3		
0.0198 mm.	49.4		
0.0117 mm.	43.5		
0.0084 mm.	39.5		
0.0061 mm.	33.6		
0.0031 mm.	22.0		
0.0013 mm.	11.9		

* (no specification provided)

Soil Description

Tan silty clay (CL) with sand and mica

Atterberg Limits

PL= 22 LL= 45 PI= 23

Coefficients

D_{90}= 0.1475 D_{85}= 0.1063 D_{60}= 0.0397
D_{50}= 0.0219 D_{30}= 0.0050 D_{15}= 0.0018
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-7-6(19)

Remarks

Source of Sample: 2F-11-171U **Depth:** 45' - 47'
Sample Number: T4 **Date:** 7-31-12

BURNS COOLEY DENNIS, INC.
Ridgeland, Mississippi

Client: ERDC
Project: Sacramento JET Testing Phase II
Project No: 120320 **Figure** 14

Tested By: EP/JE **Checked By:** EP

Classification and Condition of Lexan Tube Sample

Sheet No.: 15

Date Extruded: 7/23/2012

Project: Sacramento JET Testing Phase II

Job No.: 120320

Boring No.: 2F-11-173U

Sample No.: T1

Depth, ft.: 37 - 39

Extruded By: EP/JE

Recovery: 14" (As Denoted on Field Log)

Tube Length: 16" (As Measured in Lab)

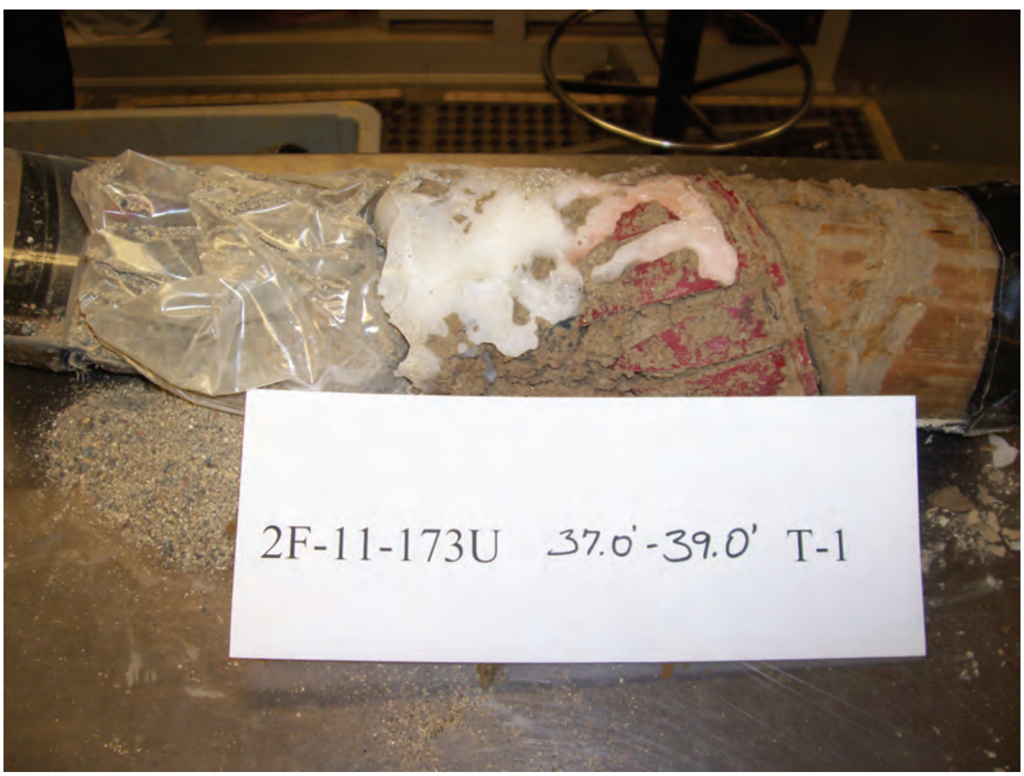
Depth	Classification and Condition of Sample	Test Assignments
0	Bag of Sand (6")	
6"	Wax (3")	
12"	Tan clayey silt (ML), slightly sandy, with mica (7")	

Remarks:

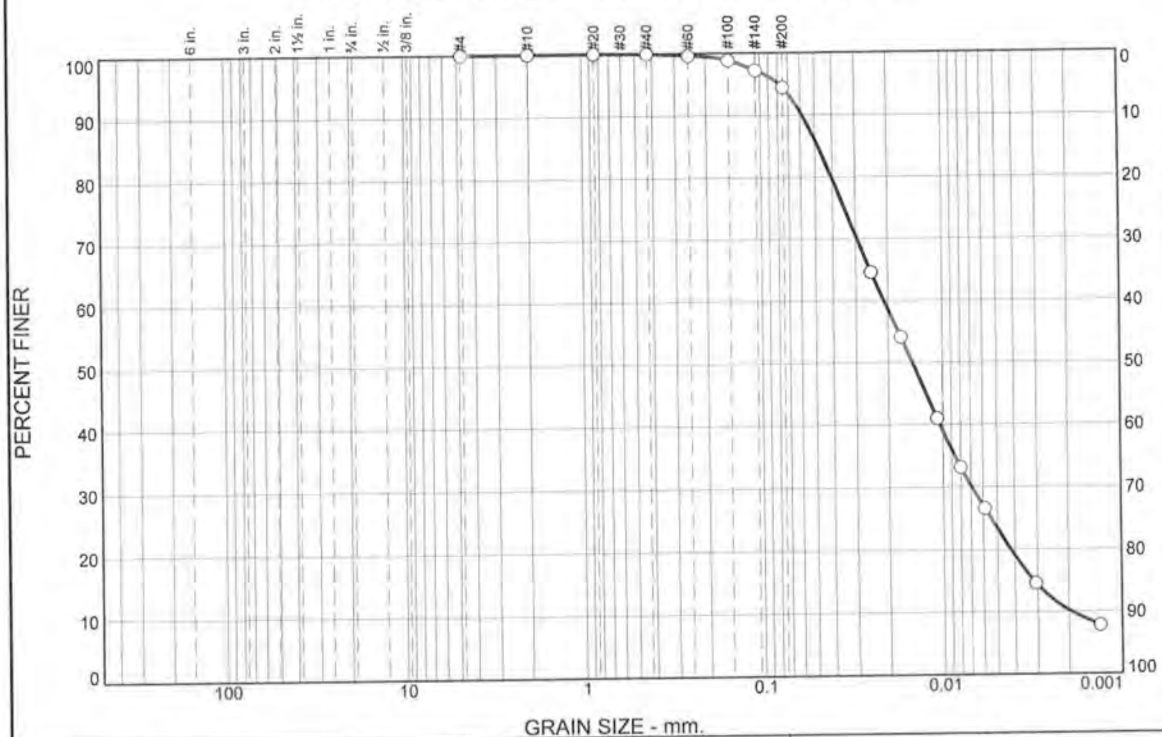
Burns Cooley Dennis, Inc.
Geotechnical and Materials Engineering Consultants

Burns Cooley Dennis, Inc.
551 Sunnybrook Road
Ridgeland, Mississippi 39157
Phone (601)-856-9911
Fax (601)-856-9774

Figure B15. Sample from Boring 2F-11-173U Tube 1 with depth of 37.0 to 39.0 ft.



Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.1	5.4	71.1	23.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	100.0		
#40	99.9		
#60	99.6		
#100	98.9		
#140	97.2		
#200	94.5		
0.0247 mm.	64.6		
0.0171 mm.	54.1		
0.0108 mm.	41.0		
0.0080 mm.	33.1		
0.0059 mm.	26.6		
0.0031 mm.	14.6		
0.0013 mm.	7.8		

* (no specification provided)

Soil Description

Tan clayey silt (ML), slightly sandy, with mica

Atterberg Limits

PL= 29 LL= 36 PI= 7

Coefficients

D_{90}= 0.0586 D_{85}= 0.0481 D_{60}= 0.0211
D_{50}= 0.0148 D_{30}= 0.0069 D_{15}= 0.0032
D_{10}= 0.0019 C_u= 10.84 C_c= 1.17

Classification

USCS= ML AASHTO= A-4(8)

Remarks

Source of Sample: 2F-11-173U **Depth:** 37' - 39'
Sample Number: T1 **Date:** 8-1-12

BURNS COOLEY DENNIS, INC.

Ridgeland, Mississippi

Client: ERDC
Project: Sacramento JET Testing Phase II
Project No: 120320 **Figure** 15

Tested By: JE/EP **Checked By:** EP

Classification and Condition of Lexan Tube Sample

Sheet No.: 16

Date Extruded: 7/23/2012

Project: **Sacramento JET Testing Phase II**

Job No.: **120320**

Boring No.: **2F-11-173U** Sample No.: **T4** Depth, ft.: **43 - 45**

Extruded By: EP/JE

Recovery: 23" (As Denoted on Field Log) Tube Length: 16" (As Measured in Lab)

	Classification and Condition of Sample	Test Assignments
0		
6"	Tan sandy silt (ML) (16")	
12"		

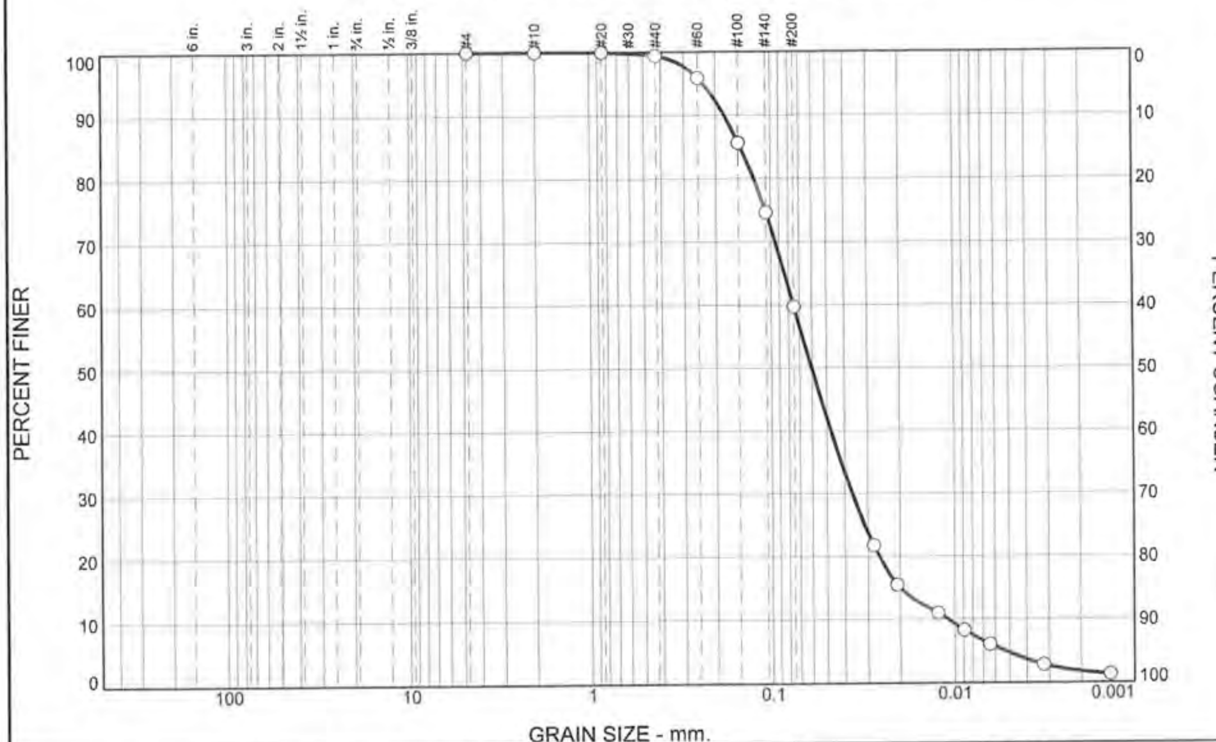
Remarks:

Burns Cooley Dennis, Inc.
Geotechnical and Materials Engineering Consultants

Burns Cooley Dennis, Inc.
551 Sunnybrook Road
Ridgeland, Mississippi 39157
Phone (601)-856-9911
Fax (601)-856-9774

Figure B16. Sample from Boring 2F-11-173U Tube 4 with depth of 43.0 to 45.0 ft.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.6	39.7	55.0	4.7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	100.0		
#40	99.4		
#60	95.9		
#100	85.7		
#140	74.6		
#200	59.7		
0.0279 mm.	21.8		
0.0207 mm.	15.5		
0.0124 mm.	11.0		
0.0089 mm.	8.3		
0.0064 mm.	6.1		
0.0032 mm.	2.8		
0.0014 mm.	1.3		

* (no specification provided)

Soil Description

Tan sandy silt (ML)

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.1792 D_{85}= 0.1463 D_{60}= 0.0754
D_{50}= 0.0603 D_{30}= 0.0365 D_{15}= 0.0200
D_{10}= 0.0109 C_u= 6.93 C_c= 1.62

Classification

USCS= ML AASHTO= A-4(0)

Remarks

Source of Sample: 2F-11-173U **Depth:** 43' - 45'
Sample Number: T4 **Date:** 8-1-12

BURNS COOLEY DENNIS, INC.

Ridgeland, Mississippi

Client: ERDC
Project: Sacramento JET Testing Phase II
Project No: 120320 **Figure** 16

Tested By: EP/JE **Checked By:** EP

Classification and Condition of Lexan Tube Sample

Sheet No.: 17

Date Extruded: 7/23/2012

Project: **Sacramento JET Testing Phase II**

Job No.: **120320**

Boring No.: **2F-11-174U** Sample No.: **T2** Depth, ft.: **37 - 39**

Extruded By: EP/JE

Recovery: 19" (As Denoted on Field Log) Tube Length: 17" (As Measured in Lab)

Depth	Classification and Condition of Sample	Test Assignments
0		
6"	Bag of Sand (6")	
12"	Tan silt (ML) with sand (11")	

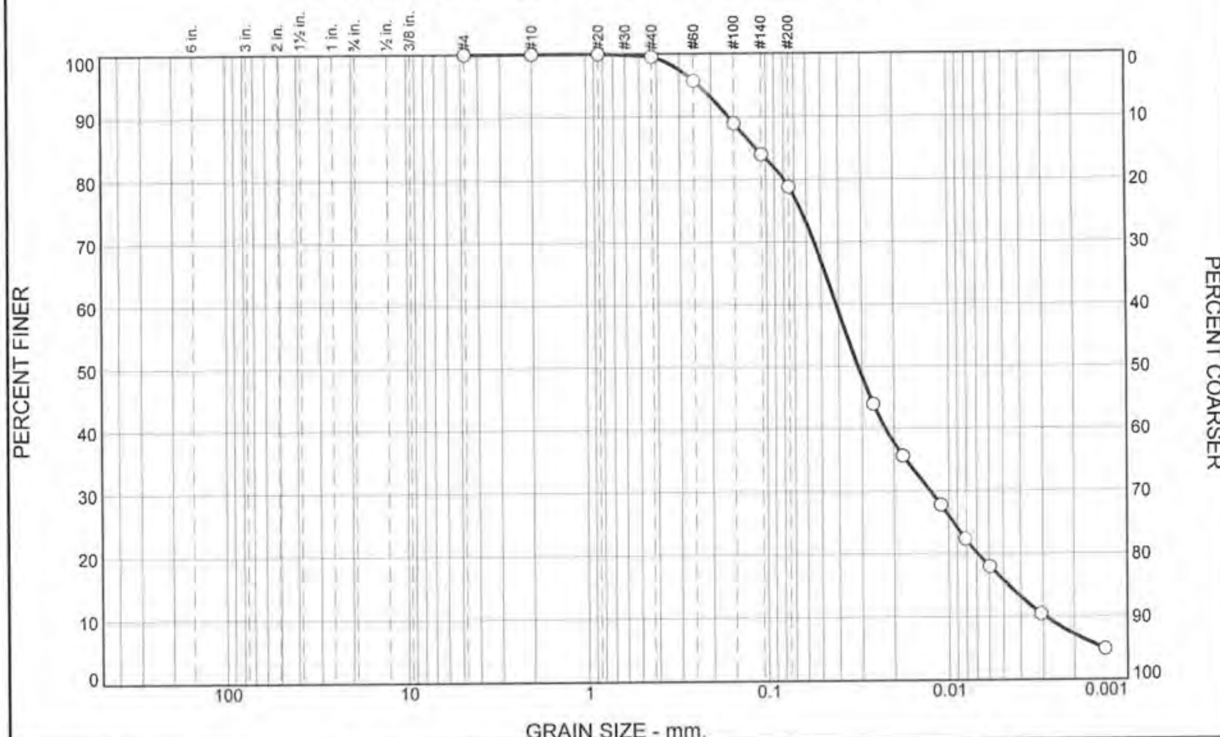
Remarks:

Burns Cooley Dennis, Inc.
Geotechnical and Materials Engineering Consultants

Burns Cooley Dennis, Inc. 551 Sunnybrook Road Ridgeland, Mississippi 39157 Phone (601)-856-9911 Fax (601)-856-9774

Figure B17. Sample from Boring 2F-11-174U Tube 1 with depth of 37.0 to 39.0 ft.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.5	20.6	63.1	15.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	100.0		
#40	99.5		
#60	95.7		
#100	88.9		
#140	84.0		
#200	78.9		
0.0260 mm.	44.0		
0.0179 mm.	35.6		
0.0110 mm.	27.8		
0.0081 mm.	22.4		
0.0059 mm.	18.0		
0.0031 mm.	10.5		
0.0013 mm.	4.9		

* (no specification provided)

Soil Description

Tan silt (ML) with sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.1615 D_{85}= 0.1141 D_{60}= 0.0414
D_{50}= 0.0315 D_{30}= 0.0126 D_{15}= 0.0047
D_{10}= 0.0029 C_u= 14.14 C_c= 1.32

Classification

USCS= ML AASHTO= A-4(0)

Remarks

Source of Sample: 2F-11-174U **Depth:** 37' - 39'
Sample Number: T2 **Date:** 8-1-12

BURNS COOLEY DENNIS, INC. Ridgeland, Mississippi	Client: ERDC Project: Sacramento JET Testing Phase II Project No: 120320 Figure 17

Tested By: EP/JE **Checked By:** EP

Classification and Condition of Lexan Tube Sample

Sheet No.: 18

Date Extruded: 7/23/2012

Project: Sacramento JET Testing Phase II

Job No.: 120320

Boring No.: 2F-11-174U

Sample No.: T4

Depth, ft.: 44 - 46

Extruded By: EP/JE

Recovery: 21 (As Denoted on Field Log)

Tube Length: 16" (As Measured in Lab)

	Classification and Condition of Sample	Test Assignments
0	Bag of Sand (2")	
	Wax (1")	
6"		
	Tan and light gray silt (ML), slightly clayey (13")	
12"		

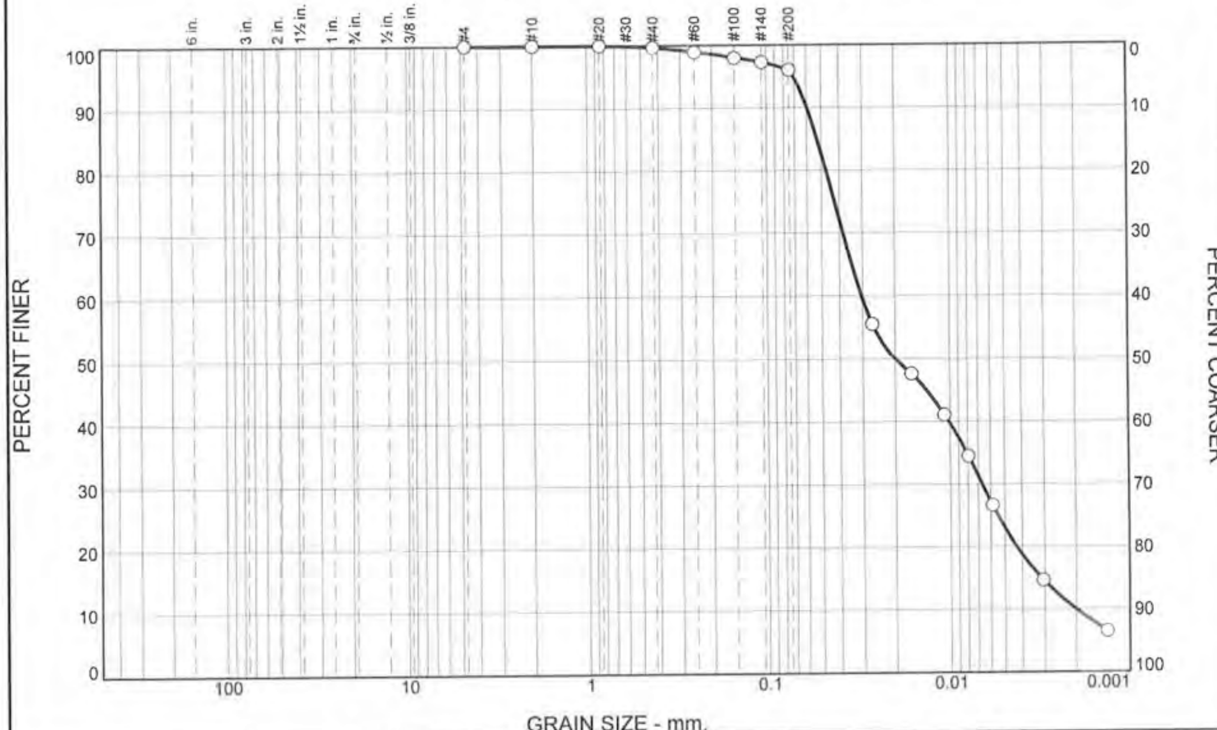
Remarks:

Burns Cooley Dennis, Inc.
Geotechnical and Materials Engineering Consultants

Burns Cooley Dennis, Inc.
551 Sunnybrook Road
Ridgeland, Mississippi 39157
Phone (601)-856-9911
Fax (601)-856-9774

Figure B18. Sample from Boring 2F-11-174U Tube 4 with depth of 44.0 to 46.0 ft.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.3	3.7	73.0	23.0

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	100.0		
#40	99.7		
#60	98.9		
#100	98.0		
#140	97.3		
#200	96.0		
0.0267 mm.	55.5		
0.0163 mm.	47.7		
0.0108 mm.	41.1		
0.0079 mm.	34.5		
0.0059 mm.	26.7		
0.0031 mm.	14.7		
0.0013 mm.	6.5		

* (no specification provided)

Soil Description

Tan and light gray silt (ML), slightly clayey

Atterberg Limits

PL= 38 LL= 42 PI= 4

Coefficients

D_{90}= 0.0597 D_{85}= 0.0527 D_{60}= 0.0304
D_{50}= 0.0200 D_{30}= 0.0067 D_{15}= 0.0031
D_{10}= 0.0020 C_u= 15.12 C_c= 0.72

Classification

USCS= ML AASHTO= A-5(8)

Remarks

Source of Sample: 2F-11-174U **Depth:** 44' - 46'
Sample Number: T4 **Date:** 8-1-12

BURNS COOLEY DENNIS, INC.

Ridgeland, Mississippi

Client: ERDC
Project: Sacramento JET Testing Phase II
Project No: 120320 **Figure** 18

Tested By: EP/JE **Checked By:** EP

Classification and Condition of Lexan Tube Sample

Sheet No.: 19

Date Extruded: 7/23/2012

Project: **Sacramento JET Testing Phase II**

Job No.: **120320**

Boring No.: **2F-11-175U** Sample No.: **T2**

Depth, ft.: **46 - 48**

Extruded By: EP/JE

Recovery: 21" (As Denoted on Field Log) Tube Length: 16" (As Measured in Lab)

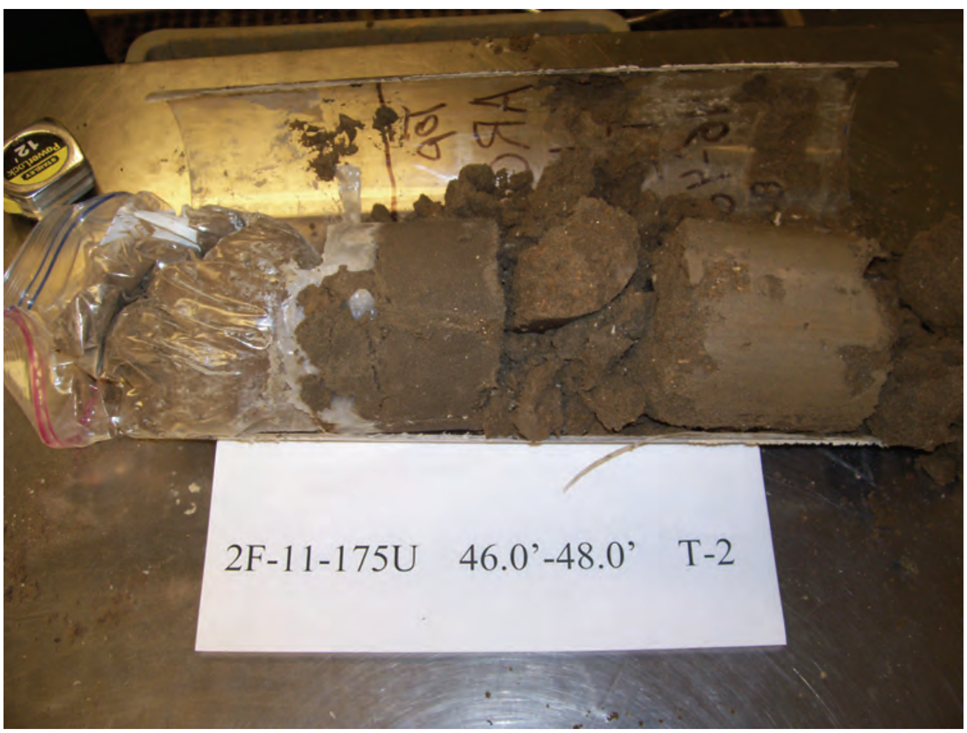
Depth	Classification and Condition of Sample	Test Assignments
0	Bag of Sand (4")	
	Wax (1")	
6"		
12"	Tan silty fine to medium sand (SM) (11")	

Remarks:

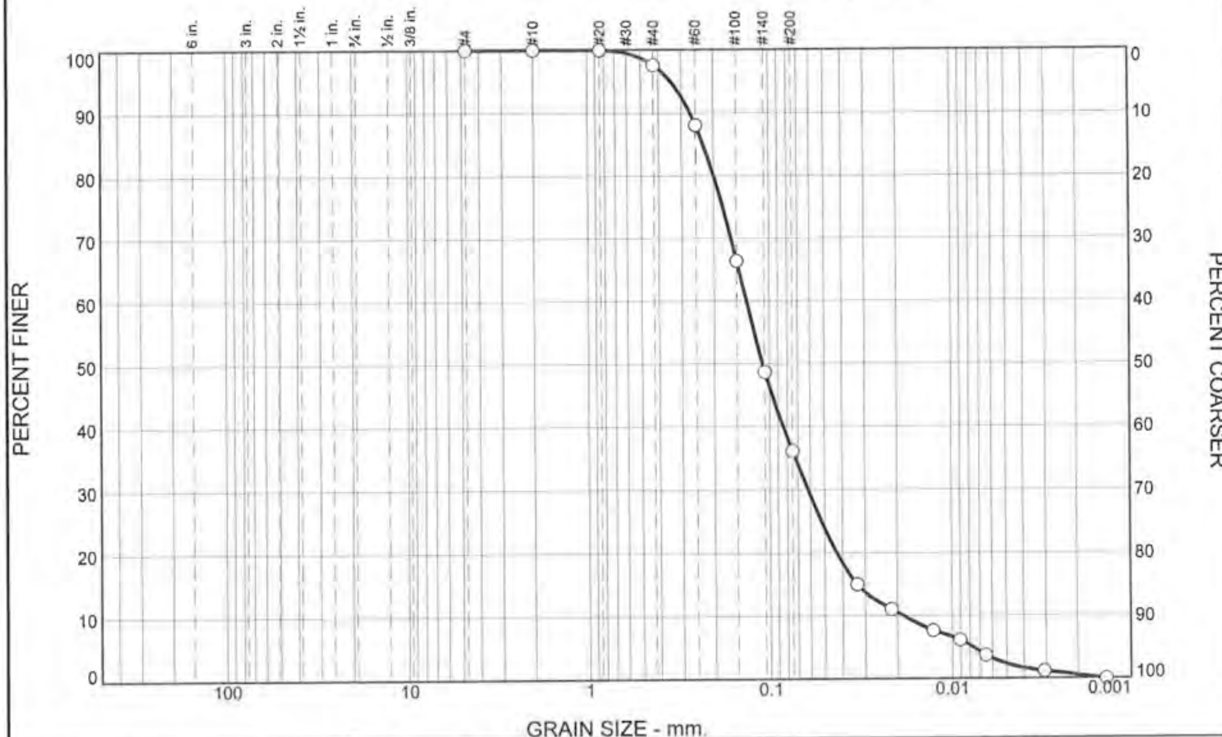
Burns Cooley Dennis, Inc.
Geotechnical and Materials Engineering Consultants

Burns Cooley Dennis, Inc.
551 Sunnybrook Road
Ridgeland, Mississippi 39157
Phone (601)-856-9911
Fax (601)-856-9774

Figure B19. Sample from Boring 2F-11-175U Tube-2 with depth of 46.0 to 48.0 ft.



Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	2.4	61.5	33.8	2.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	99.9		
#40	97.6		
#60	88.0		
#100	66.4		
#140	48.7		
#200	36.1		
0.0332 mm.	15.0		
0.0216 mm.	11.1		
0.0127 mm.	7.6		
0.0091 mm.	6.2		
0.0065 mm.	3.7		
0.0031 mm.	1.2		
0.0014 mm.			

* (no specification provided)

Soil Description

Tan silty fine to medium sand (SM)

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.2680 D_{85}= 0.2279 D_{60}= 0.1330
D_{50}= 0.1091 D_{30}= 0.0618 D_{15}= 0.0332
D_{10}= 0.0185 C_u= 7.18 C_c= 1.55

Classification

USCS= SM AASHTO= A-4(0)

Remarks

Source of Sample: 2F-11-175U **Depth:** 46' - 48'
Sample Number: T2
Date: 8-1-12

BURNS COOLEY DENNIS, INC.
Ridgeland, Mississippi

Client: ERDC
Project: Sacramento JET Testing Phase II
Project No: 120320 **Figure** 19

Tested By: EP/JE **Checked By:** EP

Classification and Condition of Lexan Tube Sample

Sheet No.: 20

Date Extruded: 7/23/2012

Project: **Sacramento JET Testing Phase II**

Job No.: **120320**

Boring No.: **2F-11-175U** Sample No.: **T3** Depth, ft.: **48 - 50**

Extruded By: EP/JE

Recovery: 16" (As Denoted on Field Log) Tube Length: 16" (As Measured in Lab)

Depth	Classification and Condition of Sample	Test Assignments
0	Bag of Sand (5")	
6"	Wax (1")	
12"	Tan and light gray silt (ML) (10")	

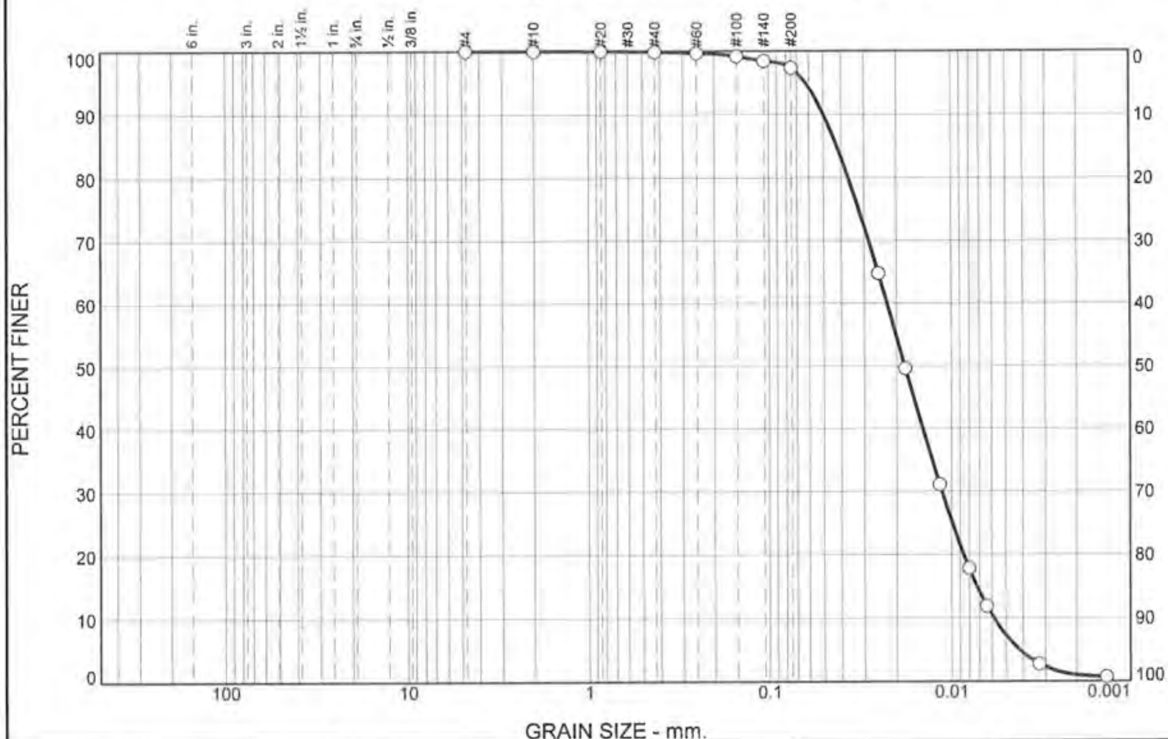
Remarks:

Burns Cooley Dennis, Inc.
Geotechnical and Materials Engineering Consultants

Burns Cooley Dennis, Inc.
551 Sunnybrook Road
Ridgeland, Mississippi 39157
Phone (601)-856-9911
Fax (601)-856-9774

Figure B20. Sample from Boring 2F-11-175U Tube-3 with depth of 48.0 to 50.0 ft.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.1	2.6	90.0	7.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	100.0		
#40	99.9		
#60	99.7		
#100	99.2		
#140	98.4		
#200	97.3		
0.0251 mm.	64.8		
0.0179 mm.	49.6		
0.0116 mm.	31.1		
0.0080 mm.	17.9		
0.0064 mm.	11.9		
0.0032 mm.	2.8		
0.0014 mm.	0.7		

* (no specification provided)

Soil Description

Tan and light gray silt (ML)

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.0500 D_{85}= 0.0422 D_{60}= 0.0226
D_{50}= 0.0181 D_{30}= 0.0113 D_{15}= 0.0073
D_{10}= 0.0058 C_u= 3.86 C_c= 0.97

Classification

USCS= ML AASHTO= A-4(0)

Remarks

Source of Sample: 2F-11-175U **Depth:** 48' - 50'
Sample Number: T3

Date: 8-2-12

BURNS COOLEY DENNIS, INC.

Ridgeland, Mississippi

Client: ERDC
Project: Sacramento JET Testing Phase II
Project No: 120320 **Figure** 20

Tested By: EP/JE **Checked By:** EP

Classification and Condition of Lexan Tube Sample

Sheet No.: 21

Date Extruded: 7/23/2012

Project: **Sacramento JET Testing Phase II**

Job No.: **120320**

Boring No.: **2F-11-177U** Sample No.: **T3** Depth, ft.: **33 - 35**

Extruded By: EP/JE

Recovery: 21" (As Denoted on Field Log) Tube Length: 16" (As Measured in Lab)

0			Classification and Condition of Sample	Test Assignments
			Bag of Sand (3")	
			Wax (1")	
6"				
			Tan and light gray clayey silt (ML) with sand and mica (12")	
12"				

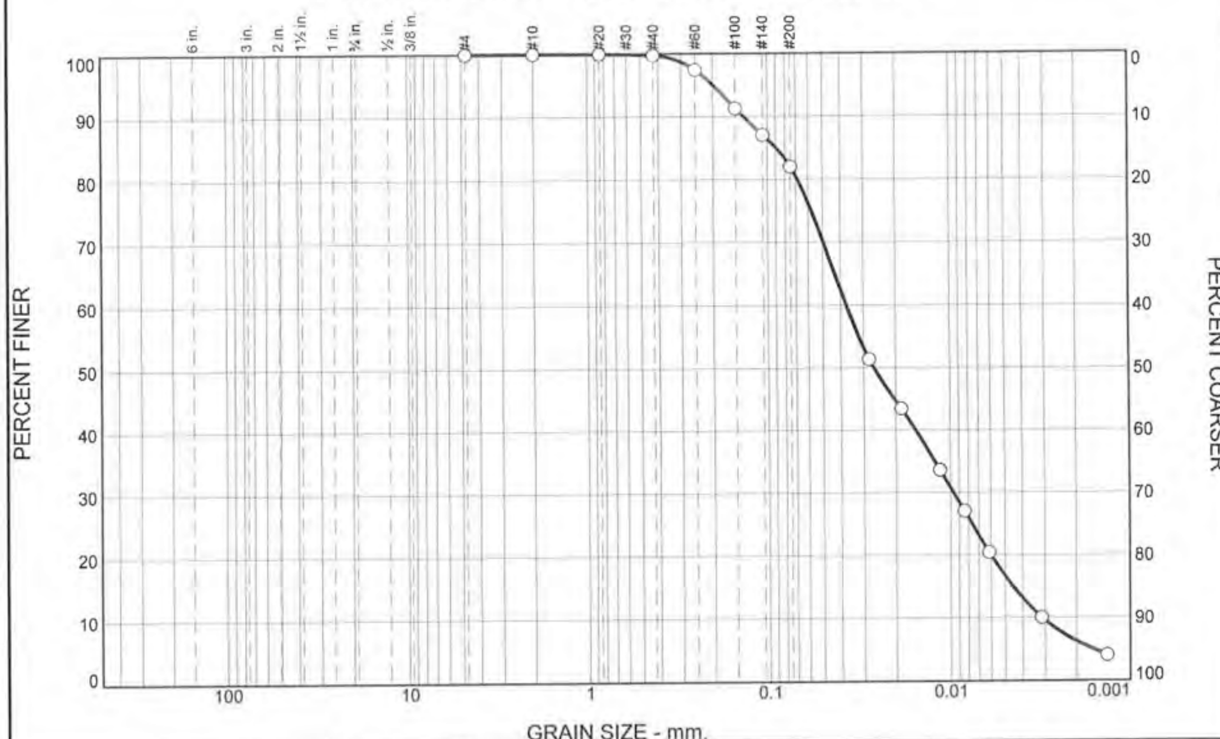
Remarks:

Burns Cooley Dennis, Inc.
Geotechnical and Materials Engineering Consultants

Burns Cooley Dennis, Inc.
551 Sunnybrook Road
Ridgeland, Mississippi 39157
Phone (601)-856-9911
Fax (601)-856-9774

Figure B21. Sample from Boring 2F-11-177U Tube-3 with depth of 33.0 to 35.0 ft.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.2	17.8	65.4	16.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	100.0		
#40	99.8		
#60	97.4		
#100	91.3		
#140	87.0		
#200	82.0		
0.0280 mm.	51.4		
0.0187 mm.	43.5		
0.0114 mm.	33.6		
0.0084 mm.	27.0		
0.0061 mm.	20.4		
0.0031 mm.	10.0		
0.0013 mm.	4.0		

* (no specification provided)

Soil Description

Tan and light gray clayey silt (ML) with sand and mica

Atterberg Limits

PL= 31 LL= 37 PI= 6

Coefficients

D_{90}= 0.1358 D_{85}= 0.0897 D_{60}= 0.0372
D_{50}= 0.0263 D_{30}= 0.0097 D_{15}= 0.0045
D_{10}= 0.0031 C_u= 11.86 C_c= 0.80

Classification

USCS= ML AASHTO= A-4(6)

Remarks

Source of Sample: 2F-11-177U **Depth:** 33' - 35'
Sample Number: T3 **Date:** 8-2-12

BURNS COOLEY DENNIS, INC.

Ridgeland, Mississippi

Client: ERDC
Project: Sacramento JET Testing Phase II
Project No: 120320 **Figure** 21

Tested By: EP/JE **Checked By:** EP

Classification and Condition of Lexan Tube Sample

Sheet No.: 22

Date Extruded: 7/23/2012

Project: **Sacramento JET Testing Phase II**

Job No.: **120320**

Boring No.: **2F-11-178AU** Sample No.: **T1** Depth, ft.: **14 - 16**

Extruded By: EP/JE

Recovery: 24" (As Denoted on Field Log) Tube Length: 16" (As Measured in Lab)

Depth	Classification and Condition of Sample	Test Assignments
0	Wax (1")	
6"		
	Tan and light gray silt (ML) with sand and mica (15")	
12"		

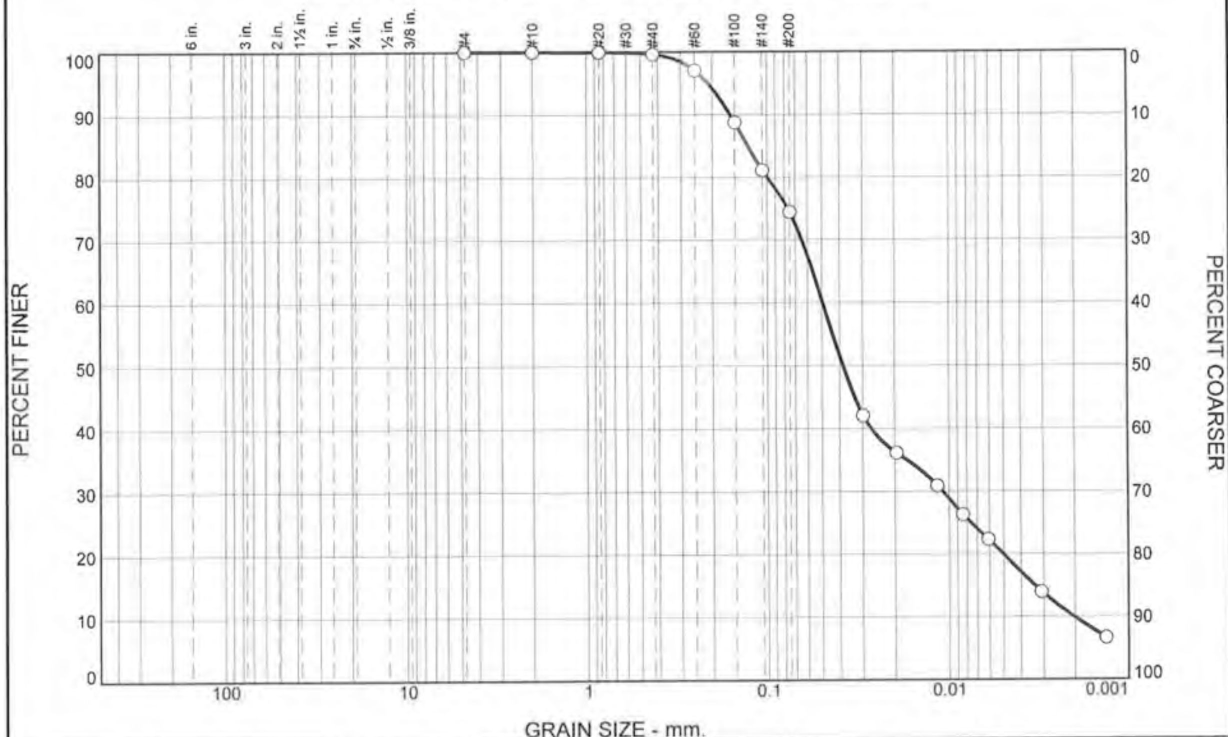
Remarks:

Burns Cooley Dennis, Inc.
Geotechnical and Materials Engineering Consultants

Burns Cooley Dennis, Inc.
551 Sunnybrook Road
Ridgeland, Mississippi 39157
Phone (601)-856-9911
Fax (601)-856-9774

Figure B22. Sample from Boring 2F-11-178U Tube-1 with depth of 14.0 to 16.0 ft.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.4	25.2	54.5	19.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	99.9		
#40	99.6		
#60	97.0		
#100	88.7		
#140	81.1		
#200	74.4		
0.0298 mm.	42.1		
0.0195 mm.	36.2		
0.0116 mm.	30.9		
0.0084 mm.	26.3		
0.0061 mm.	22.4		
0.0031 mm.	14.0		
0.0013 mm.	6.7		

* (no specification provided)

Soil Description

Tan and light gray silt (ML) with sand and mica

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.1592 D_{85}= 0.1272 D_{60}= 0.0495
D_{50}= 0.0384 D_{30}= 0.0109 D_{15}= 0.0034
D_{10}= 0.0020 C_u= 24.26 C_c= 1.17

Classification

USCS= ML AASHTO= A-4(0)

Remarks

Source of Sample: 2F-11-178AU **Depth:** 14' - 16'
Sample Number: T1 **Date:** 8-2-12

BURNS COOLEY DENNIS, INC.

Ridgeland, Mississippi

Client: ERDC
Project: Sacramento JET Testing Phase II
Project No: 120320 **Figure** 22

Tested By: EP/JE **Checked By:** EP

Classification and Condition of Lexan Tube Sample

Sheet No.: 23

Date Extruded: 7/23/2012

Project: **Sacramento JET Testing Phase II**

Job No.: **120320**

Boring No.: **2F-11-179U**

Sample No.: **T1**

Depth, ft.: **13 - 15**

Extruded By: EP/JE

Recovery: 20" (As Denoted on Field Log)

Tube Length: 16" (As Measured in Lab)

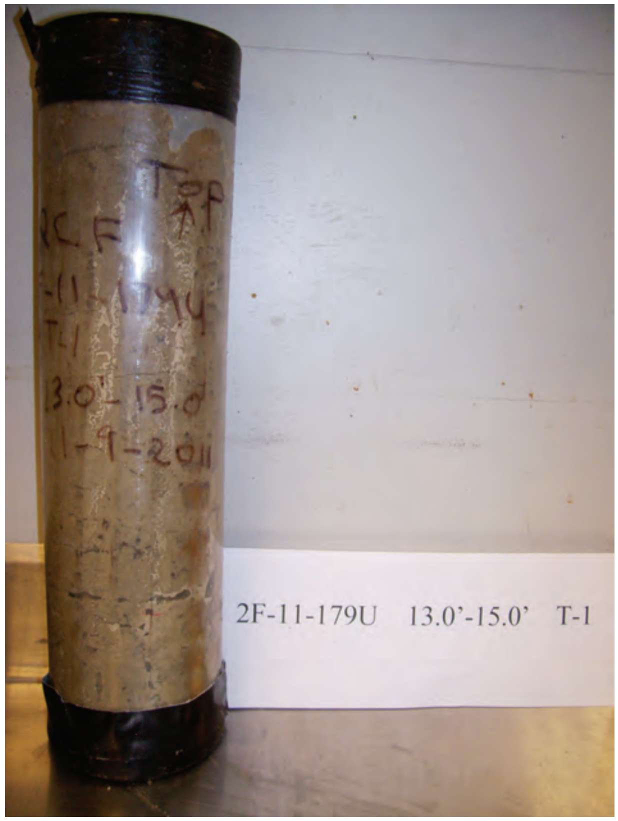
Depth	Classification and Condition of Sample	Test Assignments
0	Gravel (1")	
	Wax (1")	
6"		
	Tan and light gray clayey silt (ML), slightly sandy (14")	
12"		

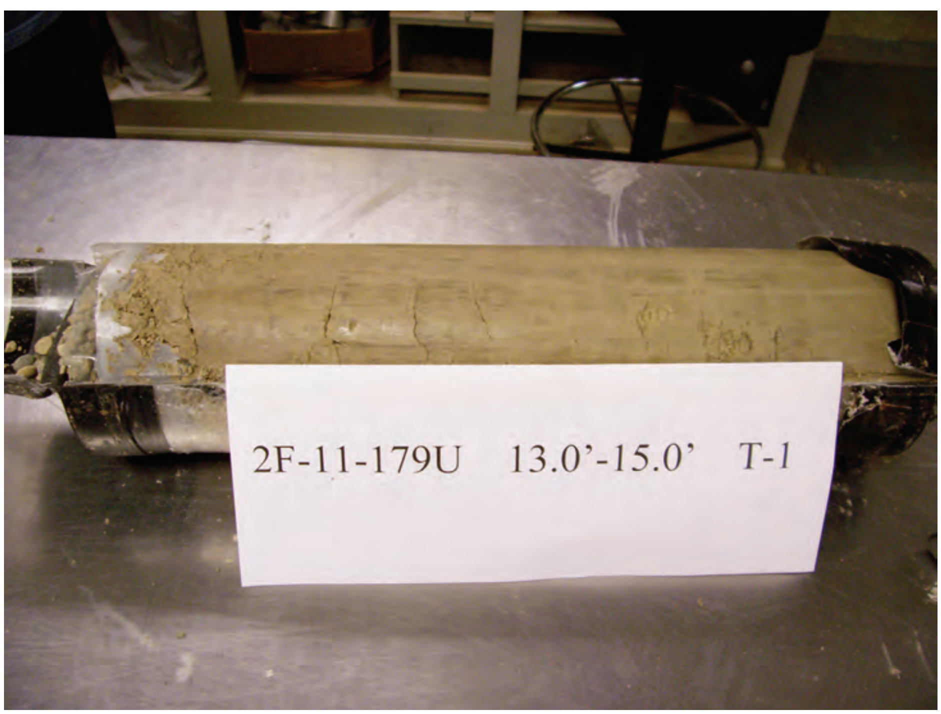
Remarks:

Burns Cooley Dennis, Inc.
Geotechnical and Materials Engineering Consultants

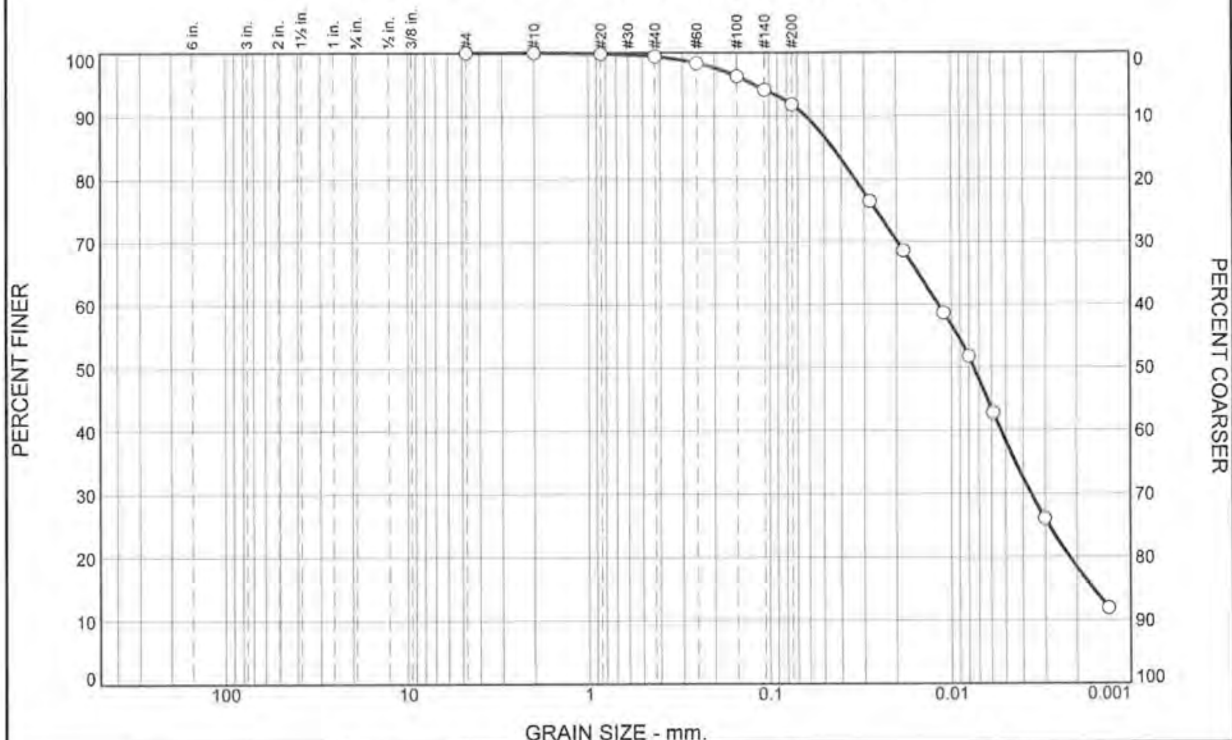
Burns Cooley Dennis, Inc.
551 Sunnybrook Road
Ridgeland, Mississippi 39157
Phone (601)-856-9911
Fax (601)-856-9774

Figure B23. Sample from Boring 2F-11-179U Tube-1 with depth of 13.0 to 15.0 ft.





Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.6	7.5	53.6	38.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	99.8		
#40	99.4		
#60	98.3		
#100	96.3		
#140	94.2		
#200	91.9		
0.0279 mm.	76.5		
0.0183 mm.	68.6		
0.0110 mm.	58.7		
0.0080 mm.	51.7		
0.0059 mm.	42.8		
0.0030 mm.	26.1		
0.0013 mm.	11.9		

* (no specification provided)

Soil Description

Tan and light gray clayey silt (ML), slightly sandy

Atterberg Limits

PL= 30 LL= 48 PI= 18

Coefficients

D_{90}= 0.0629 D_{85}= 0.0447 D_{60}= 0.0118
D_{50}= 0.0075 D_{30}= 0.0036 D_{15}= 0.0016
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO= A-7-5(20)

Remarks

Source of Sample: 2F-11-179U **Depth:** 13' - 15'
Sample Number: T1

Date: 7-31-12

BURNS COOLEY DENNIS, INC.

Ridgeland, Mississippi

Client: ERDC
Project: Sacramento JET Testing Phase II
Project No: 120320 **Figure** 23

Tested By: EP/JE **Checked By:** EP

Classification and Condition of Lexan Tube Sample

Sheet No.: 24

Date Extruded: 7/23/2012

Project: **Sacramento JET Testing Phase II**

Job No.: **120320**

Boring No.: **2F-11-179U**

Sample No.: **T4**

Depth, ft.: **24 - 26**

Extruded By: EP/JE

Recovery: 15.5" (As Denoted on Field Log)

Tube Length: 16" (As Measured in Lab)

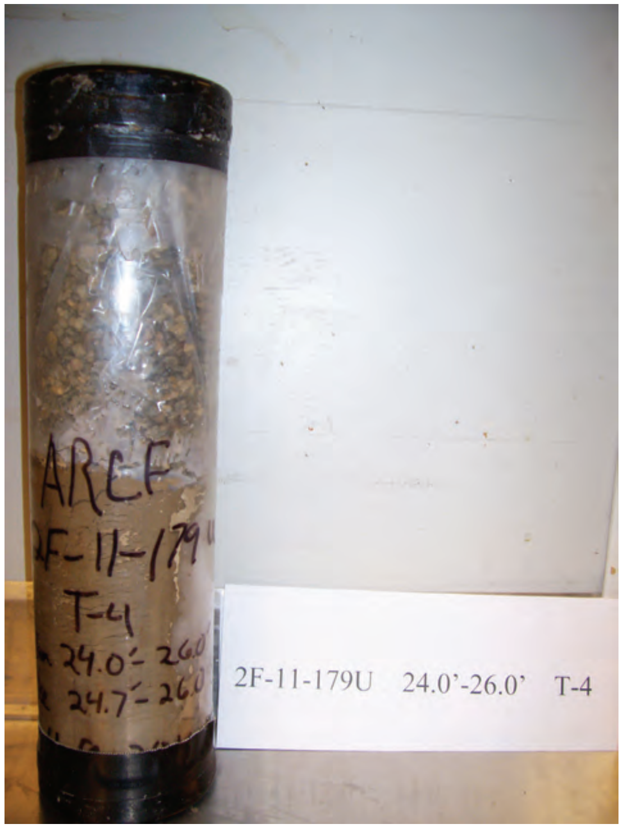
0	Classification and Condition of Sample	Test Assignments
6"	Bag of Gravel (8")	
	Wax (1")	
12"	Tan and light gray silt (ML)	

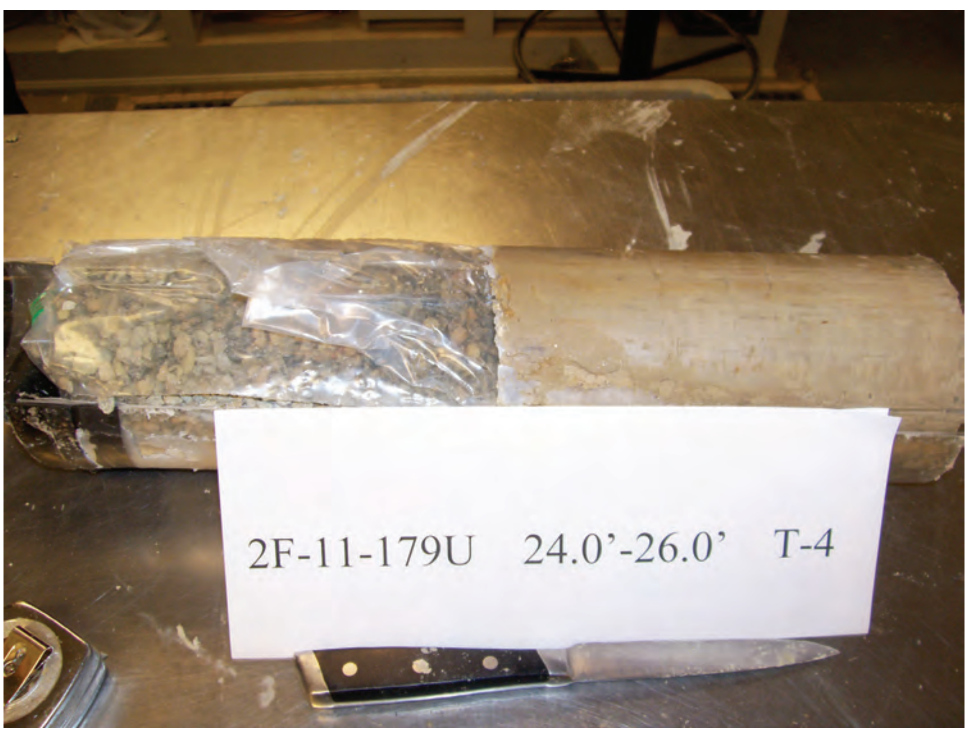
Remarks:

Burns Cooley Dennis, Inc.
Geotechnical and Materials Engineering Consultants

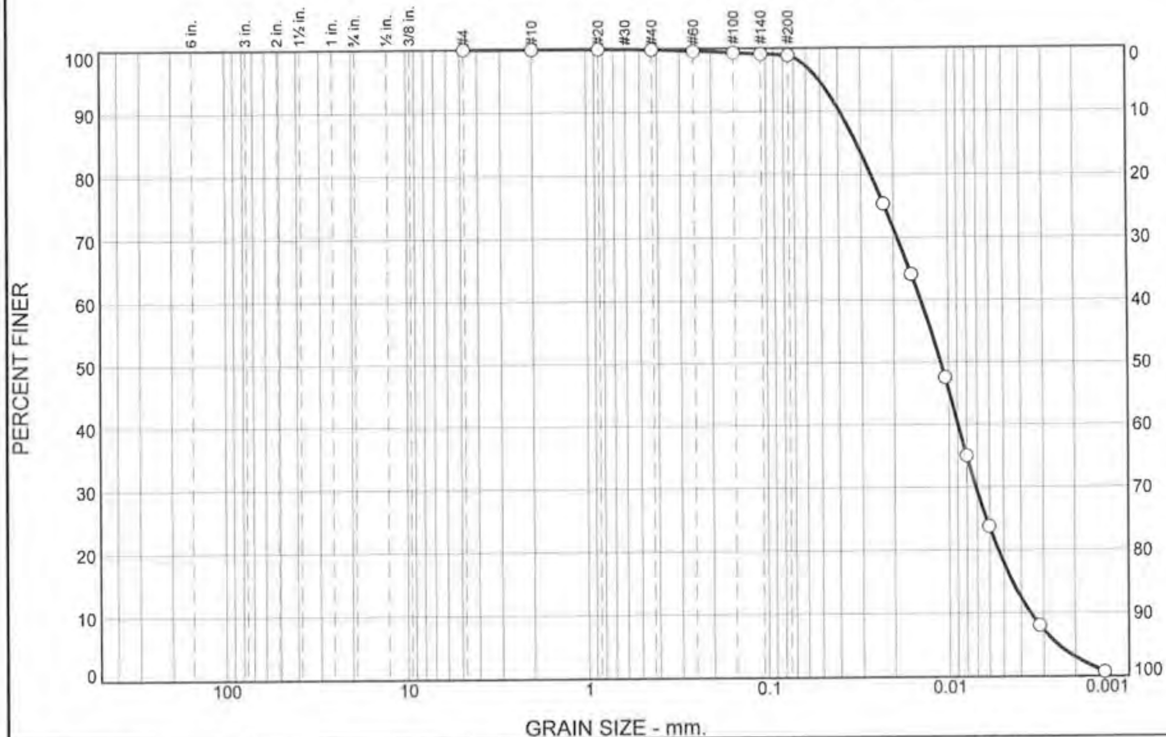
Burns Cooley Dennis, Inc.
551 Sunnybrook Road
Ridgeland, Mississippi 39157
Phone (601)-856-9911
Fax (601)-856-9774

Figure B24. Sample from Boring 2F-11-179U Tube-4 with depth of 24.0 to 26.0 ft.





Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.1	1.0	81.0	17.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	100.0		
#40	99.9		
#60	99.6		
#100	99.3		
#140	99.1		
#200	98.9		
0.0226 mm.	75.3		
0.0160 mm.	64.1		
0.0105 mm.	47.6		
0.0080 mm.	35.0		
0.0060 mm.	23.8		
0.0032 mm.	8.1		
0.0014 mm.	0.7		

* (no specification provided)

Soil Description

Tan and light gray silt (ML)

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.0392 D_{85}= 0.0318 D_{60}= 0.0142
D_{50}= 0.0111 D_{30}= 0.0071 D_{15}= 0.0045
D_{10}= 0.0035 C_u= 4.02 C_c= 1.01

Classification

USCS= ML AASHTO= A-4(0)

Remarks

Source of Sample: 2F-11-179U **Depth:** 24' - 26'
Sample Number: T4 **Date:** 8-2-12

BURNS COOLEY DENNIS, INC.
Ridgeland, Mississippi

Client: ERDC
Project: Sacramento JET Testing Phase II
Project No: 120320 **Figure** 24

Tested By: EP/JE **Checked By:** EP

Classification and Condition of Lexan Tube Sample

Sheet No.: 25

Date Extruded: 7/23/2012

Project: **Sacramento JET Testing Phase II**

Job No.: **120320**

Boring No.: **2F-11-180U** Sample No.: **T2** Depth, ft.: **26 - 28**

Extruded By: EP/JE

Recovery: 12" (As Denoted on Field Log) Tube Length: 16" (As Measured in Lab)

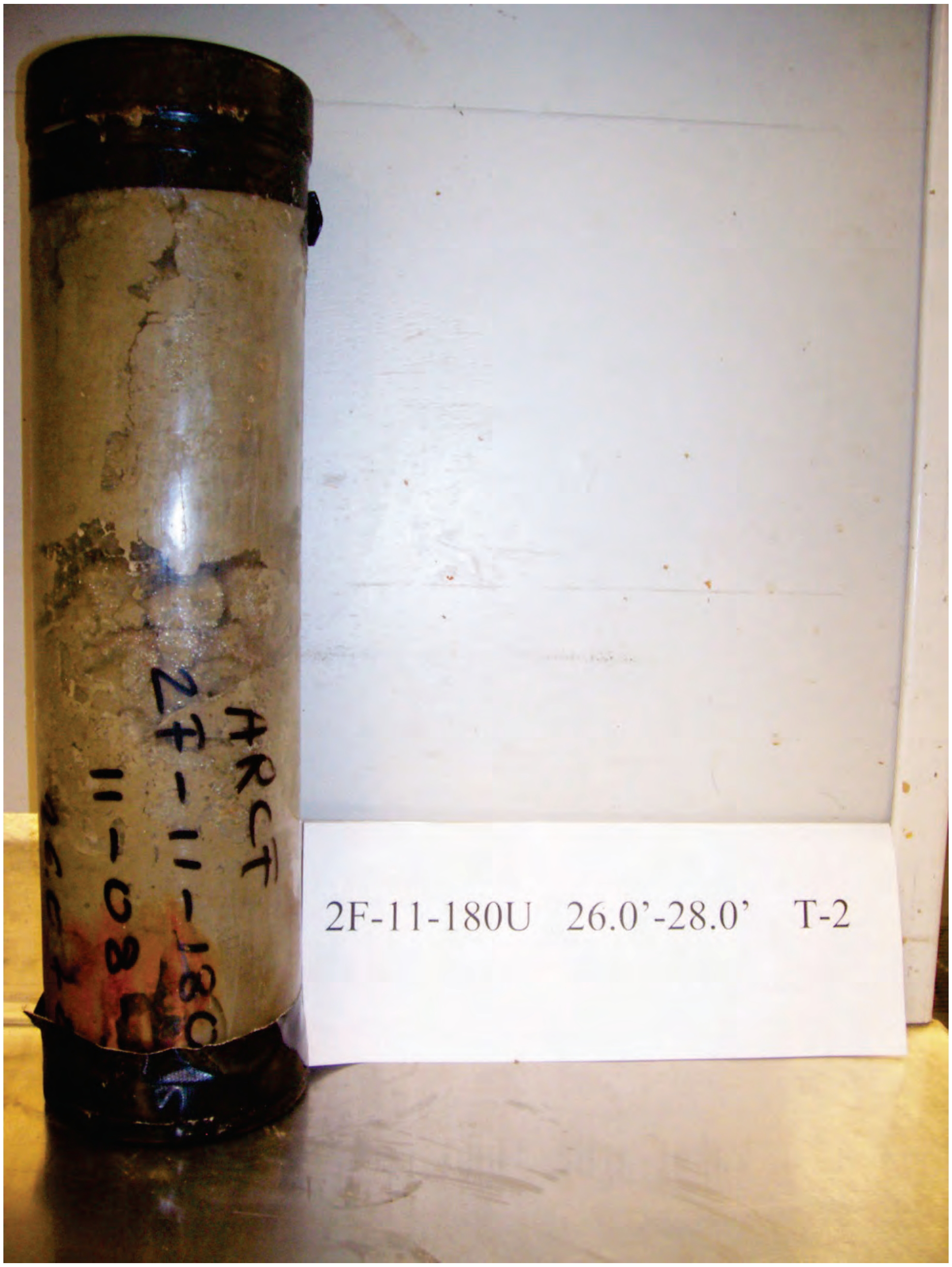
0	Classification and Condition of Sample	Test Assignments
6"	Tan clayey silt (ML) with sand (16")	
12"		

Remarks:

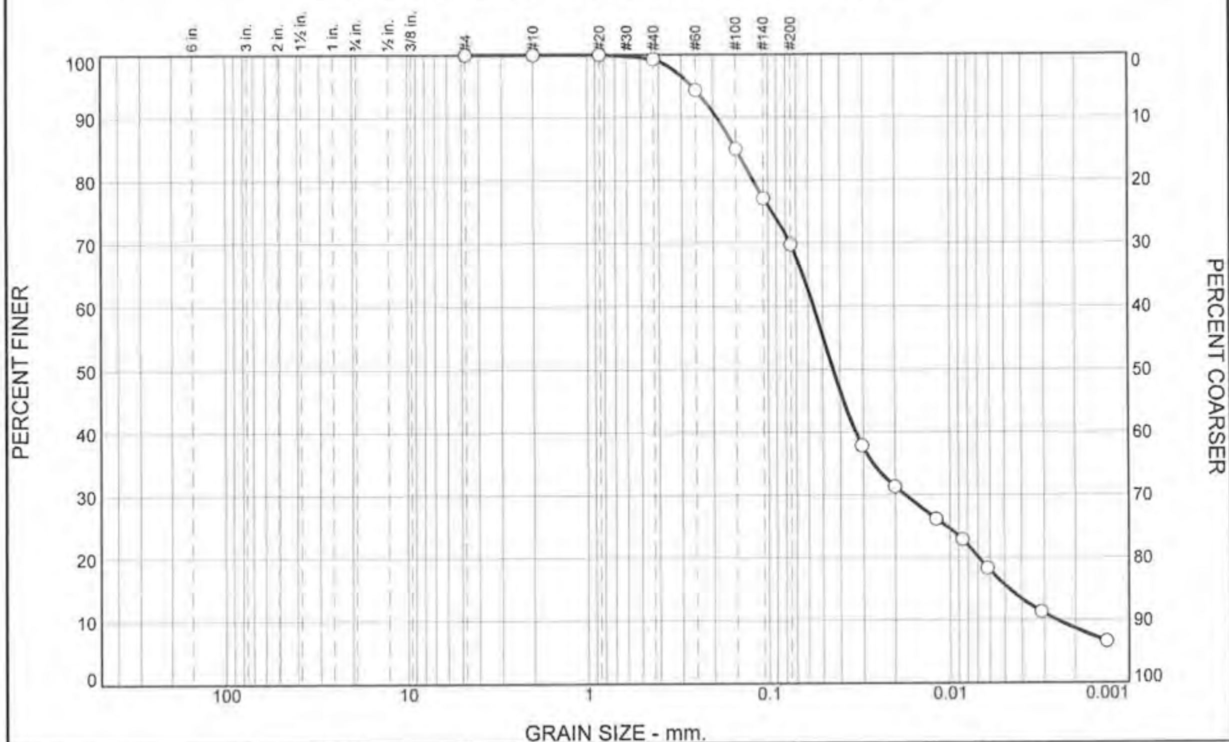
Burns Cooley Dennis, Inc.
Geotechnical and Materials Engineering Consultants

Burns Cooley Dennis, Inc.
551 Sunnybrook Road
Ridgeland, Mississippi 39157
Phone (601)-856-9911
Fax (601)-856-9774

Figure B25. Sample from Boring 2F-11-180U Tube-2 with depth of 26.0 to 28.0 ft.



Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.7	29.6	54.1	15.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	100.0		
#40	99.3		
#60	94.3		
#100	85.0		
#140	77.1		
#200	69.7		
0.0305 mm.	37.9		
0.0201 mm.	31.4		
0.0119 mm.	26.1		
0.0086 mm.	22.9		
0.0062 mm.	18.3		
0.0031 mm.	11.3		
0.0013 mm.	6.6		

* (no specification provided)

Soil Description

Tan clayey silt (ML) with sand

Atterberg Limits

PL= 30 LL= 46 PI= 16

Coefficients

D_{90}= 0.1916 D_{85}= 0.1502 D_{60}= 0.0562
D_{50}= 0.0437 D_{30}= 0.0176 D_{15}= 0.0047
D_{10}= 0.0026 C_u= 21.92 C_c= 2.16

Classification

USCS= ML AASHTO= A-7-5(11)

Remarks

Source of Sample: 2F-11-180U **Depth:** 26' - 28'
Sample Number: T2
Date: 8-2-12

BURNS COOLEY DENNIS, INC.

Ridgeland, Mississippi

Client: ERDC
Project: Sacramento JET Testing Phase II
Project No: 120320 **Figure** 25

Tested By: EP/JE

Table B1. Sacramento JET Testing – Phase II.

Project : Sacramento JET Testing - Phase II

Job No. 120320

Sheet No. 1

Date: 23-Jul-12

Boring No. 2F -11	138U	138U	139U	141U	141U	142U	143U	144U	145U	148U
Sample No.	T1	T4	T4	T1	T3	T3	T3	T1	T2	T2
Depth, ft	25-27	49-51	46-48	25-27	46.5-48.5	35-37	33-35	46-48	48-50	36-38
Description										
Penetrometer										
AL / Siv. / -200 / Vis.	AL	AL	AL	AL	AL	AL	AL	AL	AL	AL
Test Method for Water (Moisture) Content of Soil and Rock (AASHTO T 265 / ASTM D 2216-06)										
Can No.										
Wet Wt + Tare										
Dry Wt. + Tare										
Tare Wt,	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Wt.of Dry Sample										
Wt.of Water										
Water Content, %										
Test Method for Percent Passing No. 200 Sieve (ASTM D1140-00)										
Can No.										
Dry Wt+Tare(Before Wash										
Dry Wt+Tare(After Wash)										
Tare Wt,										
Dry Wt (Before Wash)										
Dry Wt. (After Wash)										
% Passing 200 Sieve										
Test Method for Liquid Limit of Soils (ASTM D 4318-00 / AASHTO T89)										
Tested By:	JE	NB	EP	EP	JE	NB	EP	NB	NB	NB
Can No.		298	261		217	316	152	239	616	
Wet Wt + Tare		**49.08**	**44.20**		**48.60**	**53.76**	**45.25**	**54.87**	**51.49**	
Dry Wt. + Tare		**45.05**	**40.08**		**42.41**	**48.24**	**41.50**	**47.97**	**44.61**	
No. Blows		**26**	**25**		**28**	**21**	**25**	**25**	**23**	
Tare Wt.		**31.31**	**30.89**		**30.10**	**31.51**	**31.11**	**29.80**	**30.59**	
Wt.of Dry Sample		13.74	9.19		12.31	16.73	10.39	18.17	14.02	
Wt.of Water		4.03	4.12		6.19	5.52	3.75	6.9	6.88	
Water Content, % (w)		29.3	44.8		50.3	33.0	36.1	38.0	49.1	
Liquid Limit (LL)*	**NP**	**29**	**45**	**NP**	**51**	**32**	**36**	**38**	**49**	**NP**
Test Method for Plastic Limit and Plasticity Index of Soils (ASTM 4318 / AASHTO T90)										
Can No.		73	7		254	116	204	137	238	
Wet Wt + Tare		**39.82**	**42.94**		**41.24**	**43.48**	**42.09**	**41.15**	**41.36**	
Dry Wt. + Tare		**37.55**	**40.14**		**38.49**	**40.51**	**39.24**	**39.18**	**38.70**	
Tare Wt.		**29.67**	**31.31**		**31.00**	**31.37**	**30.10**	**31.13**	**29.73**	
Wt.of Dry Sample		7.88	8.83		7.49	9.14	9.14	8.05	8.97	
Wt.of Water		2.27	2.8		2.75	2.97	2.85	1.97	2.66	
Plastic Limit	**NP**	**29**	**32**	**NP**	**37**	**32**	**31**	**24**	**30**	**NP**
Plasticity Index	**NP**	**NP**	**13**	**NP**	**14**	**NP**	**5**	**14**	**19**	**NP**

*LL=w(N/25)^0.121 = kw											
	N	20	21	22	23	24	26	27	28	29	30
	k	0.973	0.980	0.985	0.990	0.995	1.005	1.010	1.014	1.018	1.022

Tested By: je, hs, ep, nb   Reduced By: hs   Checked By: ______   Date of Recap: 28-Jul-12

Burns Cooley Dennis, Inc.
Geotechnical and Materials Engineering Consultants

Table B1. (Continued).

Sheet No. 2

Project : Sacramento JET Testing - Phase II Job No. 120320 Date: 23-Jul-12

Boring No. 2F -11	149U	151U	152U	171U	173U	173U	174U	174U	175U	175U
Sample No.	T2	T2	T2	T4	T1	T4	T2	T4	T2	T3
Depth, ft	27-29	26-28	25-27	45-47	37-39	43-45	37-39	44-46	46-48	48-50
Description										
Penetrometer										
AL / Siv. / -200 / Vis.	AL	AL	AL	AL	AL	AL	AL	AL	AL	AL
Test Method for Water (Moisture) Content of Soil and Rock (AASHTO T 265 / ASTM D 2216-06)										
Can No.										
Wet Wt + Tare										
Dry Wt. + Tare										
Tare Wt,	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Wt.of Dry Sample										
Wt.of Water										
Water Content, %										
Test Method for Percent Passing No. 200 Sieve (ASTM D1140-00)										
Can No.										
Dry Wt+Tare(Before Wash										
Dry Wt+Tare(After Wash)										
Tare Wt,										
Dry Wt. (Before Wash)										
Dry Wt. (After Wash)										
% Passing 200 Sieve										
Test Method for Liquid Limit of Soils (ASTM D 4318-00 / AASHTO T89)										
Tested By:	NB	EP	JE	NB	NB	NB	NB	NB	NB	NB
Can No.				308	369			616		
Wet Wt + Tare				56.73	52.77			50.60		
Dry Wt. + Tare				49.36	46.97			44.76		
No. Blows				26	21			28		
Tare Wt.				33.00	31.01			30.60		
Wt.of Dry Sample				16.36	15.96			14.16		
Wt.of Water				7.37	5.8			5.84		
Water Content, % (w)				45.0	36.3			41.2		
Liquid Limit (LL)*	NP	NP	NP	45	36	NP	NP	42	NP	NP
Test Method for Plastic Limit and Plasticity Index of Soils (ASTM 4318 / AASHTO T90)										
Can No.				102	180			308		
Wet Wt + Tare				42.47	40.89			42.77		
Dry Wt. + Tare				40.41	38.53			40.10		
Tare Wt.				31.21	30.28			33.00		
Wt.of Dry Sample				9.2	8.25			7.1		
Wt.of Water				2.06	2.36			2.67		
Plastic Limit	NP	NP	NP	22	29	NP	NP	38	N/P	NP
Plasticity Index	NP	NP	NP	23	7	NP	NP	4	NP	NP

*LL=w(N/25)$^{0.121}$	N	20	21	22	23	24	26	27	28	29	30
= kw	k	0.973	0.980	0.985	0.990	0.995	1.005	1.010	1.014	1.018	1.022

Tested By: je, hs, ep, nb Reduced By: hs Checked By: ______ Date of Recap: 28-Jul-12

Burns Cooley Dennis, Inc.
Geotechnical and Materials Engineering Consultants

Table B1. (Concluded).

Sheet No. 3

Project : Sacramento JET Testing - Phase II Job No. 120320 Date: 23-Jul-12

Boring No. 2F -11	177U	178AU	179U	179U	180U					
Sample No.	T3	T1	T1	T4	T2					
Depth, ft	33-35	14-16	13-15	24-26	26-28					
Description										
Penetrometer										
AL / Siv. / -200 / Vis.	AL	AL	AL	AL	AL					

Test Method for Water (Moisture) Content of Soil and Rock (AASHTO T 265 / ASTM D 2216-06)

Can No.										
Wet Wt + Tare										
Dry Wt. + Tare										
Tare Wt,	n/a	n/a	n/a	n/a	n/a					
Wt.of Dry Sample										
Wt.of Water										
Water Content, %										

Test Method for Percent Passing No. 200 Sieve (ASTM D1140-00)

Can No.										
Dry Wt+Tare(Before Wash										
Dry Wt+Tare(After Wash)										
Tare Wt,										
Dry Wt (Before Wash)										
Dry Wt (After Wash)										
% Passing 200 Sieve										

Test Method for Liquid Limit of Soils (ASTM D 4318-00 / AASHTO T89)

Tested By:	JE	NB	NB	NB	JE					
Can No.	343		298	257	226					
Wet Wt + Tare	53.65		54.36	47.24	51.00					
Dry Wt. + Tare	47.49		46.79	42.40	44.45					
No. Blows	24		23	29	26					
Tare Wt.	30.72		31.31	30.82	30.20					
Wt.of Dry Sample	16.77		15.48	11.58	14.25					
Wt.of Water	6.16		7.57	4.84	6.55					
Water Content, % (w)	36.7		48.9	41.8	46.0					
Liquid Limit (LL)*	37	NP	48	43	46					

Test Method for Plastic Limit and Plasticity Index of Soils (ASTM 4318 / AASHTO T90)

Can No.	354		180	13	172					
Wet Wt + Tare	42.60		44.93	41.38	41.98					
Dry Wt. + Tare	39.93		41.55	38.25	39.49					
Tare Wt.	31.38		30.28	30.89	31.06					
Wt.of Dry Sample	8.55		11.27	7.36	8.43					
Wt.of Water	2.67		3.38	3.13	2.49					
Plastic Limit	31	NP	30	43	30					

Plasticity Index	6	NP	18	NP	16					
*LL=w(N/25)$^{0.121}$ N	20	21	22	23	24	26	27	28	29	30
= kw k	0.973	0.980	0.985	0.990	0.995	1.005	1.010	1.014	1.018	1.022

Tested By: je, hs, ep, nb Reduced By: hs Checked By: ______ Date of Recap: 28-Jul-12

Burns Cooley Dennis, Inc.
Geotechnical and Materials Engineering Consultants

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
May 2017	Final	

4. TITLE AND SUBTITLE

Laboratory Jet Erosion Tests on the Lower American River Soil Samples, Sacramento, CA – Phase 2

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)

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5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

C4CL8D

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

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8. PERFORMING ORGANIZATION REPORT NUMBER

ERDC/GSL TR-17-8

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

U.S. Army Corps of Engineers, Sacramento District
1325 J Street
Sacramento, CA 95814

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION / AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

14. ABSTRACT

This report summarizes the results of 42 laboratory Jet Erosion Tests performed on Plexiglas tube samples obtained from the Lower American River (LAR) between River Mile (RM) 6.0 and RM 10.0. The results from these tests will be used by the U.S. Army Corps of Engineers, Sacramento District, in assessments of the erosion resistance of the LAR from increases in discharge from 115,000 cfs to 160,000 cfs from Folsom Dam. The test specimens were obtained from 22, 4 in.-diam Plexiglas tube samples. The variations in values of the measured erosion parameters may have been caused by variations in the materials for some of the tested samples (i.e., when the material changed from silt/sand to clay). However, the variations in results for many of the samples were due to changes in the quality of samples. The resulting values of Erodibility Coefficient, Kd, and Critical Stress, τc, are very useful information in assessing the erodibility of riverbanks as well as the river bed itself. Because of the observed natural variability of the materials, combining the erosion parameters presented in this report with the drilling logs and local geology will provide beneficial results for assessing the stability of the LAR.

15. SUBJECT TERMS

Laboratory	Lower American River	Soil erosion
Jet erosion test	Folsom Dam (Calif.)	
	Scour (Hydraulic engineering)	

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			19b. TELEPHONE NUMBER *(include area code)*
Unclassified	Unclassified	Unclassified		157	